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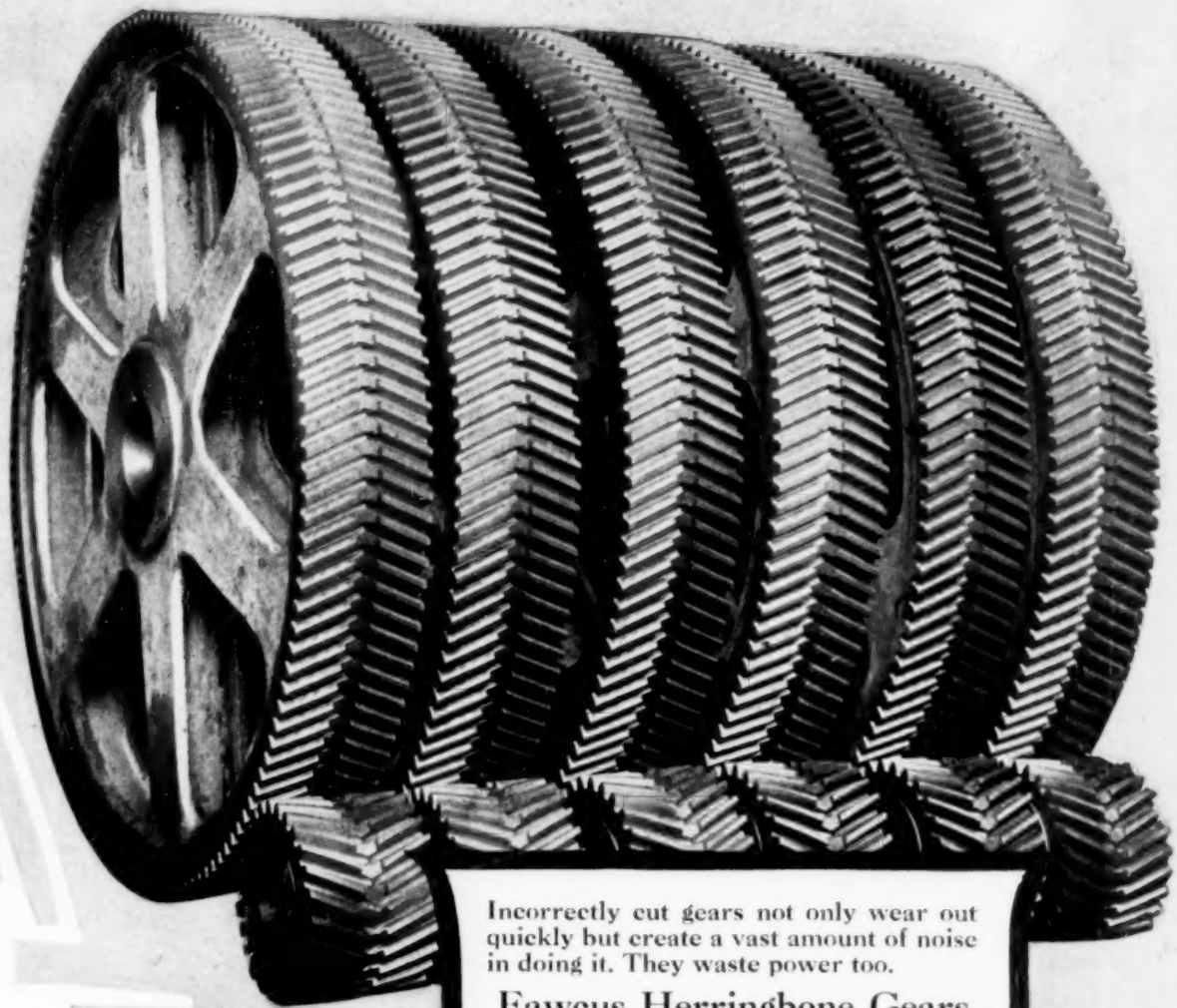
CHEMICAL & METALLURGICAL ENGINEERING



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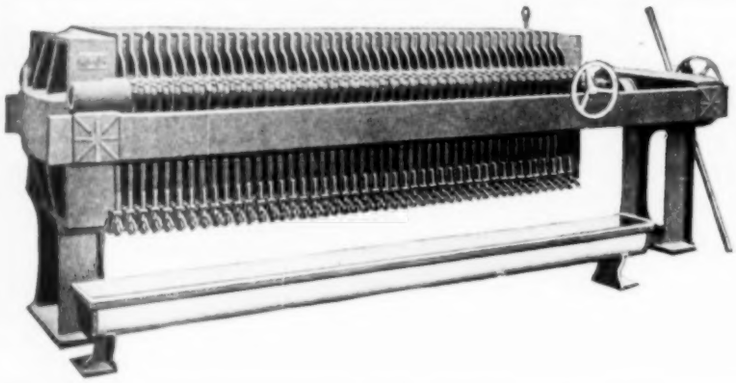

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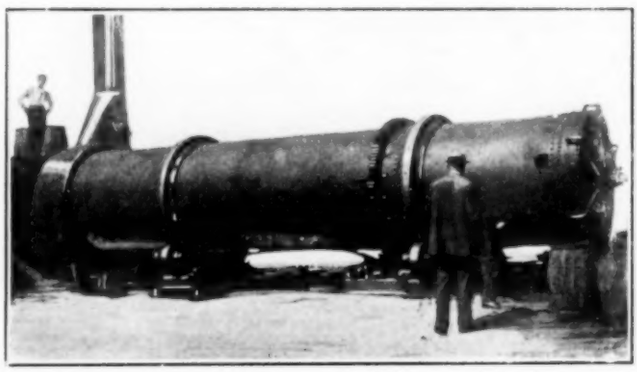

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Legislation That Passed And Legislation That Failed

THE chemical industries cannot find a great deal of comfort in the legislative status at the close of the last session of Congress, for many of the measures in which these industries are interested failed of passage. Moreover, it should be understood that the new Congress which will convene shortly will start afresh in all these matters, just as though there had not been any legislative effort made by the previous Congress. Each bill, no matter how far it had advanced in the last session, must be introduced, referred to committee, reported to each house, acted upon, sent to conference to adjust differences between the two houses, and the conference report acted upon in each house, and transmitted to the President for signature. It is easily seen why it is such a shame to have legislation fail at the end of a Congress when all this effort and expense must again be incurred for the passage of bills which were previously so near enactment.

Conspicuous among the incomplete legislation at the end of the Congress were the Army and Navy appropriation bills. In these two supply measures are included the money for chemical warfare, for the helium investigations and for other military and naval activities. The separate bill providing for the Fixed Nitrogen Corporation also failed of passage, although it was approved by the Senate in much emasculated form following amendments proposed by Senators WADSWORTH and LENROOT. This bill, which would have provided for the continued operation of the Muscle Shoals nitrate plant, died because the House Committee on Military Affairs under the chairmanship of Representative KAHN held the bill without action from Jan. 14 to the end of the session of Congress. However, it is doubtful whether the bill would have passed in any useful form even if it had been reported by this committee, since the appropriation for the Muscle Shoals project for power development through the Wilson dam was defeated. The defeat of this power measure was doubtless the result of the co-operation of two groups, one of which sought economy in expenditures, the other of which opposed the bill on the ground of policy, objecting to the Government entry into further power development, especially under circumstances where the power project was so closely associated with the nitrate plant.

In connection with power matters, special notice should be given to the failure of Congress to provide adequately for the Federal Power Commission. This and the failure to provide for reorganization of the Patent Office will mean that these two important engineering services of the Government will either mark time or actually slip backward during the coming fiscal year unless some new legislation is successfully handled in the coming session of Congress. Without a Patent Office adequately manned, business is sure to suffer. Without a Power Commission provided with suitable personnel all industry will be condemned to delay in its effort to secure adequate water power. No measure of economy can possibly justify these items of saving in appropriation. It is simply an unfortunate result of our political system that permits two Senators (SMOOT and JONES) to defeat the Power Commission measure and one Senator (NORRIS) to hold up the Patent Office bill.

It is not surprising to record that the duty-free importation of glassware and chemicals and the dyestuff import legislation remained without favorable action in the Senate. Both these measures and the emergency tariff legislation, which was vetoed by the President, will doubtless be reconsidered in connection with the general tariff revision which will be a leading measure in the new Congress. It is to be hoped that these technical matters will thus receive most sympathetic consideration in the Fordney tariff law, which will undoubtedly be enacted at an early date unless it is decided as a matter of policy to reenact the Payne-Aldrich tariff as an immediate but temporary measure. It is rumored that this may be done in order that the Republican policies of protection for industry provided by the Payne-Aldrich law may at once supersede the Democratic free-trade idea which was, of course, basic in the Underwood law of 1913, which still stands on the statute books.

With such important matters as the two remaining appropriation bills, the whole problem of taxation, tariff and revenue legislation, and the responsibility for some sort of peace treaty upon the hands of the new Congress, much minor legislation will doubtless suffer. However, it is likely that the Congressional commission appointed to investigate the needs and possibilities of Government reorganization and creation of the new Department of Public Works will be busy during the coming year. This commission under the chairmanship of Senator SMOOT is already engaged upon certain work which will doubtless lead to bills to supersede those introduced in the last Congress which received no attention after the appointment of this commission was agreed to. Incidentally this reorganization of the Government departments, in which Secretary of Commerce HOOVER will doubtless have a large influence, has an important bearing upon budget legislation. In view of this fact the technical branches of the Government service, which are those most vitally concerned, may receive the attention which they deserve, being carried forward to prominent place in the legislative program because of the desire to have the budget measures adequately considered at an early date.

What We Want Is Orders

VERY fortunately one fashion is going out—that of counting up the "needs" in steel of the railroads, or the United States as a whole, or the world. Everyone can recall how much talk there has been along this line and everyone can see that we have got nowhere with it. What we want is orders.

Needs are of no importance unless they can be expressed, and then they do not count unless they can be met. There must be the ability to buy and the ability to produce. We certainly have the ability to produce, although we did not have it during the first nine months of last year. Then there was heavy demand, yet the steel mills did not average over an 80 per cent operation.

In a measure the transaction of business is a cycle of operations. One buys from another, he from a third and so on around to the first again. One line cannot be very active unless other lines are active. The farmer raises corn, the breakfast food factory buys it, the story writer consumes the corn flakes and the farmer subscribes for the magazine. A partial exception to the ordinary circle of transactions occurs when there is construction work, for it is set not against present consumption but prospective consumption. If the respective prices of corn, corn flakes, stories and magazines have proper relationship, no matter what the basis, business can be transacted, but construction work must cost in relation to values in future. Hence when prices in general are declining, construction work lags, while when prospects are for higher prices investors hasten to take hold.

As steel is used largely for construction purposes, its selling price needs to be in relation to future values in general. In addition to this there is the situation that there are large "needs" for steel, yet the needs are not expressed in orders, because those who need steel cannot afford to buy. The gap can be bridged by movement from each side, by increasing ability to buy and by the quantity of steel available for a given sum of money being increased. The per ton price of steel can never mount so high as to prevent steel from being used for watch springs, but it can be too high to warrant the building of a given bridge. The steel-making capacity is so large that it requires demand from all possible sources. Steel must make as wide a market for itself as can be found.

We have had enough of this talk about there being great needs in steel, of the world being short of steel. Let the talk be dismissed by a sweeping admission that it is all true. The vital fact today is that the great need is for steel orders. The constructive work to be done is in getting down the cost of producing steel. There has been some talk lately in various quarters about the necessity of steel prices being reduced. The matter of selling price is of very little moment just now. The steel price list is ephemeral. There is no demand in the market just now, and if there is an improper gap between production cost and market asking prices the gap will no doubt be reduced in ample time. The vital thing is the cost of production, which is too high. The labor cost is too high. Wage rates are too high in relation to the cost of living and the cost of living is too high. Wholesale prices are down and the retail storekeeper is either making too much money or is not performing his function of distribution properly. Freight rates are altogether too high. The amount of money that must be paid so that a ton of finished steel may be delivered to the consumer is altogether out of a natural proportion, chiefly because the railroad payrolls, on which freight rates are based, have been entirely too high and out of all proportion to the service performed by the railroads. Analyses that may be made of "what becomes of the railroad dollar" vary widely because conditions change so rapidly. The railroad operating ratio, operating expenses to operating revenues, was 70.57 per cent in 1917 and 93.53 per cent in 1920, while now it is a still different thing. One illustrative comparison can be made, however, that the railroad payroll has lately been running at about $3,700,000,000 a year while the extra half per cent the Interstate Commerce Commission accorded the railroads under the permission given by the transportation act would, if the railroads were able to collect it by having enough traffic, amount to about $95,000,000. There is a ratio of about 39 to 1, certainly very suggestive. The steel industry has already addressed itself to these two big items, of its wages and its freight bills, as well as to many other smaller items, for the purpose of reducing costs and making a market for steel.

Labels to Inform And to Deceive

"MADE in Germany," "Made in Nippon" and "Made in U. S. A." are all labels of distinct industrial significance. It is well, therefore, that the Federal Trade Commission is giving particular attention just now to the deceptive practice which is creeping into American commerce whereby certain foreign interests and American importers seem to be co-operating in an effort toward deception of the American public and the defeat of legitimate American industry.

The Federal Trade Commission has just announced (March 5) a citation of a New York manufacturing company to show cause why it should not cease mislabeling the device which it sells. On the outside of this device a brand "White House" appears, and the company even labels the exterior portion of the device "Made in U. S. A." to convey the impression that the entire device is of domestic production. As a matter of fact the main portion of this device is made in Germany, and careful examination of the interior of the instrument shows this fact. Obviously the trade practice is a vicious one and it is to be hoped that the commission will be successful in eliminating this type of bad practice.

It is very unfortunate that each unit of chemical production, such as dyestuffs, intermediates, pharmaceuticals, etc., cannot be clearly labeled as to its original source. It might even be worth while for the American chemical industry to appeal to Congress for legislation requiring that materials important to domestic industry should be labeled as to their source. Such a plan would be entirely feasible, for on repackaging it would not be at all difficult to label properly and conspicuously the container with the source of original production. The only question would be to decide when a material refined or purified in this country has ceased to be essentially of foreign production and become properly "naturalized" as an American product. Yet there is no question that instruments and other articles of manufacture which can easily be labeled should be properly so stamped.

Actual Smoke Damage Must Cause Visible Markings

IT MUST be a source of deep satisfaction to Dr. O'GARA and his assistants to find that the conclusions they reached so early in their researches on the smoke problem have received the unqualified assent of independent investigators. The main results of their studies, started about seven years ago, are now fairly widely known and accepted by plant pathologists. Officials of their own concern, the American Smelting & Refining Co., have also been convinced of the soundness of the deductions, as witness the expenditure of several hundred thousand dollars for new flue and stack systems at various plants. While a marked reduction in the number of complaints from neighboring farmers immediately followed the completion of such improvements, the final test of all remained—whether a smelter operating under correct conditions, as determined by the researches, would be permitted to continue so to operate by a judge when deciding a so-called "smoke suit"; that is to say, whether a court could be thoroughly convinced of the efficacy of modern methods of eliminating damage by sulphur smoke.

That this final test has been successfully passed is apparent from a perusal of the report rendered by Prof. ROBERT E. SWAIN, acting as commissioner, to Federal Judge JOHNSON. Judge JOHNSON expressed the opinion over a year ago that the A. S. & R. Co. officials had "practically solved the smoke problem." They were then given the opportunity of suggesting operating stipulations embodied in an interlocutory decree, which must have been done by them with a knowledge that they could operate with a good factor of safety. Dr. SWAIN'S most painstaking and independent researches now give that company a clean bill of health.

How far apart the parties to a litigation may be is apparent from the fact that only a few years ago most operating companies stoutly contended that only solid matter in smelter smoke was dangerous, and since gases could easily be cleared from fume they were doing no damage. Farmers, on the other hand, were not able to recognize the true enemy, but were sure that in some cases a low yield of second grade crops resulted even when visual plant damage was entirely absent. Recognition that sulphur dioxide is the great trouble maker is no less an achievement than that plant damage to be real must be visible. What a task is the latter can be appreciated by any one who has tried to replace prejudice or fear by reason.

Dr. SWAIN bases his findings on the fact that repeated fumigation of plants with concentrations of sulphur dioxide too slight to give rise to foliar markings will not cause injury by reducing their vitality or the crop yield, even though visible typical discolorations are not produced. In other words, he assumes that the theory of "invisible injury," the "unsichtbare Beschädigungen," advanced especially by some of the earlier German investigators is untenable. That theory has never been supported by any conclusive evidence.

A turning point in the investigation of the effects of smelter smoke on plant life occurred early in the work of the Selby Smelter Commission when MARSTON and WELLS devised a method for the determination of sulphur dioxide which will yield results of a high degree of accuracy even at very low concentration. With this method at hand the way was at once open to a much more accurate control of fumigation experiments.

It was soon demonstrated that sulphur dioxide is absorbed very rapidly by soil, and by vegetation with which it is in contact. Sulphur dioxide in the air of a closed fumigation cabinet containing plants was also found to decrease rapidly. This observation revealed only one more weakness to add to those already recognized in the older methods of fumigation, and it was not long until apparatus was developed for the fumigation of plants by moving currents of air, rather than by still atmospheres, a type of apparatus used in all important recent work.

Therefore we now have every reason for believing that sulphur dioxide is freely tolerated at concentrations which are below those which will produce foliar markings and hence visible injury. In all probability SO_2 is even directly utilized by plants and there are no effects, immediate or remote, on their general metabolism which lead to a lowered vitality, to any interference with the processes of growth or reproduction, or to any reduction in crop yield. When the limiting concentrations under the prevailing conditions of humidity, light, temperature and duration of exposure are exceeded, resulting in injury, this is primarily a local injury, and quickly leads to discolorations which are quite typical and pronounced. When this point is reached, and not until then, can it be claimed that injury has been done.

A Review on Book Reviewers

THE Valentine Number of *Life* makes a few comments that should not be overlooked by all who write or read book reviews. "T. L. M." states that he is quite positive that book reviewers as a class are wholly misunderstood. Their nice sense of honor prevents them from associating with authors whose books they review, their relationships being with people of a lower order, such as publishers and editors. Their only knowledge of authors is of necessity derived from the past, and when one reads that ARISTOPHANES was extremely vulgar, that GOETHE was undomestic in his habits, that SHAKESPEARE deserted his wife, that SAMUEL JOHNSON gorged himself and that SHELLEY was excessively irreligious, it is quite natural that book reviewers should view all authors with distrust. The simple fact that any author writes a book is indeed quite likely to prejudice the book reviewer against him.

The complaint is that they do not actually read the book they review but use it as a peg to hang a few pet thoughts on, and not to tell what it is or what it ought to be. The fact is, of course, that reading the books is not necessary. It is not the province of book reviewers to tell what is in a book. If they did this there would be no use in offering the book to the public as food for the mind. It is only necessary to give their opinion after analyzing samples taken here and there after the fashion of a chemist working on coal. They should also have themselves under such control as to restrain themselves from writing anything clever about the book, merely for the sake of being clever, without regard to the damage done to the author and publisher.

All the big bow-wow book reviewers who are obliged by necessity to read one or even two books a day in order to keep up with the literary profession should certainly be provided with helpers, who might be apprenticed to their masters for a term of years before being classed as reviewers.

Readers' Views and Comments

Compensation of Chemists and Salesmen

To the Editor of Chemical & Metallurgical Engineering

SIR:—At a time when our various chemical societies are paying so much attention to the development and promotion of chemical industry, it may be well to investigate the compensation which these industrials are paying their chemical and technical employees. One thing is certain, the chemical societies themselves have up until this time done nothing of this character for their membership.

When the employers of professional chemists begin to weep and wail because of their unparalleled misfortune and the threatened destruction of their income, it is natural that one should examine some of the underlying causes of their distress. For example, we find that some of them employ college-trained chemists, and that they are paying these chemists from $2,000 per year all the way up to $3,000 per year. Now a capable stenographer in prosperous sales offices is frequently paid $2,000 per year, and the "college training" which she has endured may have lasted anywhere from three to five months in some "business college" at a cost of about $50 for tuition.

These chemists at two or three thousand per annum meet periodically in chemical societies, where they pass sundry resolutions asking for a high protective tariff for the dye industry, and are asked to vote in favor of the passage of certain industrial bills. At a recent meeting of one of these chemical societies the chairman before asking for a vote on a dye tariff bill asked the members if any one was able to state the text of the proposed bill and later asked if any one who had voted for the bill knew anything about the dye industry. The response to this question was a blank silence. And so we find that these $3,000 per annum chemists are working in and out of office hours for the benefit of their employers. They believe that this is necessary in order to retain their positions. Here is altruism of the purest and highest sort.

Now let us see what the average employer of chemists is giving his *salesmen* in the way of compensation. He offers to a young man with a grammar school education $2,000 a year to start as a salesman; if he possesses average ability he can earn $5,000 per year; if he possesses special ability he is later paid $7,500 and commissions; but if he is a star salesman he expects and receives $10,000 to $15,000 per year. The *star* salesman can be recognized in some firms by his acts. For example, he will send in orders to the chief chemist as to what he wants done so that the salesman's salary and commissions will be maintained. The general manager tells the chief chemist and the laboratory department of which he is the head: "You will have to get busy and help us over this trouble, for if you can't, there is no use of having a laboratory." And so the $3,000 or $5,000 chemist is warned to "get busy" so that a series of $10,000 and $15,000 salesmen may thrive.

Now let us see what the average employer of chemists is doing for his chemical adviser. He gives him a one- or two-year contract with the proviso that it may be canceled by the employer, in case there should be any "error of judgment" on the part of the employer. He gives his chemical adviser a two-weeks' vacation, and asks him to "assign all inventions and discoveries to the company."

If on the other hand you will note how the employer finds his chemists you will see such advertisements as this: "Wanted, a young college graduate, to take charge of a new laboratory. We want a young man, one who will grow up with the business. Salary to start, $1,500 per annum." Presently we find this same employer complaining bitterly about his "chemist," whereas in reality he has no chemist at all in his employ. All that he has is a young college graduate, and that was what he advertised for. He proudly boasts that "I pay my chemist what he is worth, and he is hardly worth the $1,500." The employer apparently does not realize that he is actually giving this young man a post-graduate course, and the $1,500 is merely a stipend, annuity, scholarship or bread-money while he is learning the business.

The employer will also state very seriously that many chemists are fakers, bluffers and sons of black magic. Within the last six months a representative of a prominent firm of manufacturing chemists came to me and asked if I could supply him with details for the manufacture of blue-stone or copper sulphate. He said verbatim: "I would pay as much as $50 for this information." When told that this was somewhat out of proportion to the money which he hoped to make from the process, he stated verbatim: "Well, I think I will send my man over to the Chemists' Club to the next dinner meeting. He will be able to pick up some information there, and it will cost me only the price of a dinner." This man is the executive of a flourishing chemical company. He thrives on chemists, and he pays them anywhere from $1,500 to $2,500 per annum, because in his opinion "they are not worth more."

I firmly believe that the time has arrived when chemists in each state of the Union must organize state chemical societies for the purpose of:

1. Protecting college-trained chemists from unscrupulous employers.
2. Providing honest employers with chemical advisers whose record and achievements are known.
3. Providing a bureau of "professional rating" for college-trained chemists and for such other men who have scientific knowledge of a specified industry.
4. Publishing correct advice to professional chemists regarding their legal rights in matters of employment.
5. Recommending to college professors suitable courses of instruction for chemists who are to help our American chemical industries. If, however, the college professors refuse to consider recommendations, the matter should be taken up with the college executive, because he is the man who appeals to the industrial corporations for financial assistance.
6. Restricting the use of college apparatus and equipment by professors who now really carry on a practice as "consulting chemist" and who compete directly with consulting chemists who do not receive salaries as professors. From all accounts it seems that some colleges solicit funds from the public in order to maintain a private consulting practice for a college professor. In such cases it is obvious that the college is in fact maintaining a private business conducted by one of its professors. If the professor is a valuable asset to the college, he should undoubtedly receive a

salary commensurate with the salaries paid to other persons having similar experience and ability.

7. Conducting meetings at which older practitioners will discuss the "practice of chemistry as a profession." To these meetings the chemical students of colleges should be invited, so that gradually a system of ethics may be built up without the need of a printed code.

8. Supporting a journal or other publication whereby chemists throughout the state will be kept informed of the activities of chemists and chemical industries in the state.

9. Offering to banks, investors and chambers of commerce proper guidance in the choice of chemical advisors.

10. Keeping a lookout on the water supply, gas supply and garbage disposal conditions within the cities. Demanding justice and fair treatment of the citizens by the public utility companies.

11. Advising public officials when cases arise within the state relating to pollution of the air by chemical fumes or smoke, pollution of the streams by factory waste waters or sewage, special fire hazards due to dangerous location of new factories, the sale of bad milk, butter or other food products.

12. Informing the U. S. Tariff Commission and those intrusted with the framing of tariff acts if a given industry in the state is worthy of tariff protection.

13. Securing and maintaining within the state at one or more places a modern library of books on chemistry and the sciences related to chemistry. This provides for co-operation with all existing agencies of the kind by acts as well as by resolutions.

14. Maintaining friendly relations with all other State chemical societies and providing for an interchange of information.

15. Constituting special committees of competent chemists whose business it shall be to discuss and report on the preceding "purposes."

Newark, N. J. WALTER FERGUSON.

Purity for the Pure

To the Editor of Chemical & Metallurgical Engineering

SIR:—Several of our most distinguished scientists in the teaching profession are going up and down the land expounding on a theme which might be titled "Pure Scientists Want to Remain Pure." They talk against business and commercial tendencies as applied to research and teaching with a tone almost bitter in its denunciation of business and business methods until one might be led to believe that "business" in connection with anything is a term of reproach. Now we would not quarrel with them in the matter of abstract research as long as it deals with live subjects and we would certainly favor freedom of choice in methods of procedure but must deplore the strong aversion manifested toward the ways of commerce.

Business is a science founded on economic laws quite as exact as those of chemistry, and far from being a questionable occupation is certainly as honorably practiced as other sciences, and by men of equal honor. Business men play their game for the love of the work to as great an extent as do our pedagogical friends. The main difference is that dollars are the counters in one instance and technical accomplishments in the other. Another variation lies in the fact that when the business man loses his counters he must perforce stop the play, while the college professor, supported as he is by taxation of lenient business men, can continue in the face of numerous negative results.

It is well to support research and teaching on a high plane, but certain concentration so necessary to business success will not go amiss in the schools and laboratories. The line of thought should not wander so far from the sphere of practical application as to pass like atoms in the air through the orbital strata and become lost in the universe of dreams. Until the work in schools and colleges is conducted on a business basis—till they become self-supporting—the business men who now support them through taxes and endowments will demand a certain "hewing to the line."

Were the universities left to the management of unbusinesslike faculties the result would be a decay of purpose throughout all departments. They would attain the condition of the inveterate bookworm who reads without plan for his own pleasure until he becomes nothing but mere dreamer and putters his life away in the library corridors, a sad example of premature senility.

This is not intended as a sermon against abstract science, but rather a plea from the lowbrow business outpost. Perhaps many of your readers, too modest or too busy to express their views, may concur in these opinions. F. GISTON.

Analytical Control of Electrolytic Zinc Production

To the Editor of Chemical & Metallurgical Engineering

SIR:—For the benefit of those chemists who may have tried the methods given under the above title in CHEMICAL & METALLURGICAL ENGINEERING, vol. 22, p. 651 (April 7, 1920), I should like to present a few revisions which will simplify matters in some cases.

Analysis of Leach Solution (Unpurified).—With certain kinds of solutions it is impossible to filter the precipitate obtained with H_2S unless the solution is diluted to several volumes before making the precipitation. Copper and antimony may be determined as usual in this precipitate, or copper may be precipitated with "hypo" without much dilution.

Cadmium in such a solution is easily determined as follows: Take 200 c.c. of solution. If considerable ferrous iron is present, oxidize it in presence of acid with $KMnO_4$ from a burette, avoiding excess $KMnO_4$. Add 25 g. NH_4Cl, then sufficient NH_4OH to redissolve $Zn(OH)_2$, boil, filter by suction, and wash with warm dilute NH_4OH. To the filtrate add slowly, with stirring, enough Na_2S (3 per cent solution of crystals) to precipitate copper and cadmium, plus a little excess. Roughly, $Cu \times 3.8 + Cd \times 2.2 = Na_2S.9H_2O$. Heat to boiling, let settle about one hour, and filter by suction on Büchner funnel, using three close papers, and washing with warm dilute NH_4OH. The precipitate is treated with 25 per cent H_2SO_4, etc., exactly as in the determination of cadmium in "Pure Electrolyte."

Analysis of Zinc Dust Precipitate.—The following short methods are applicable when the material is low in SiO_2 and the cadmium and zinc are entirely soluble in H_2SO_4:

Copper.—To 0.5000 g. sample in small covered beaker add 2 c.c. HNO_3 and agitate until violent action has stopped. Wash cover and sides of beaker with a fine jet of water, add a small grain of $KClO_3$, and evaporate to about 0.5 c.c. Add about 20 c.c. of water, neutralize with KOH, acidify with acetic acid, add about 0.25 g. of sodium ammonium phospate in 20 c.c. of water, and finish by the iodide method.

Cadmium and Zinc.—To 0.5000 g. sample add 40 c.c. of water, 6 c.c. H_2SO_4, and a few drops of HCl. Heat to boiling, add a drop of dilute platinum chloride, and boil about two minutes. Cool the liquid to about 40 deg. C., remove the copper as in the original method, dilute to 125 c.c., and precipitate CdS from the cold solution. The rest of the procedure is identical with the original method. H. F. BRADLEY.

Park City, Utah.

Notes on French Industries

FROM OUR SPECIAL CORRESPONDENT

PARIS, France, Feb. 15, 1921.

THE subject of nitrogen fixation is now occupying a prominent place in French financial and industrial circles. The Compagnie Nationale de l'Azote (National Nitrogen Co.), recently founded and capitalized at 12,500,000 f., hopes to obtain a license for the Haber process, which, as reported in CHEMICAL & METALLURGICAL ENGINEERING of Nov. 17, 1920, p. 956, was bought by the French Government for 50,000,000 f. from the Badische Anilin- und Soda-Fabrik; but this license privilege will require the sanction of the French Parliament. In the meantime the shareholders of the company have voted an increase of capital to 20,000,000 f., and in addition, it is rumored, to issue bonds for 100,000,000 f. This last policy will be strongly opposed, especially by the periodical *L'Engrais*, devoted to the fertilizer industry. It is also stated that the company is intimately connected with the Société Kuhlmann, which is already using the Haber process. To complicate things even more, it is expected that in the near future patent infringement litigation will start between the companies using the Haber process and the Société L'Air Liquide (Liquid Air) which uses the Georges Claude process, based on the allegation that this last process is merely a modification of the Haber process.

FINANCIAL DIFFICULTIES IN THE CHEMICAL INDUSTRY

The Société Alsacienne de Produits Chimiques, which has recently increased its capital to 30,000,000 f., as reported in my previous letter (CHEM. & MET., Feb. 23, 1921, p. 328), is now facing great financial difficulties due to the precarious situation of the Banque Industrielle de Chine (China Industrial Bank), which is the backer of the company.

The Compagnie Nationale de Matières Colorantes (National Dyes Co.), with its new plants at Oissel and Villers, is now in a position where it can work only part time and had to close and finally abandon its model research laboratory at Suresne. It is foreseen that the company will soon be forced to increase its capital.

The Usines Chimiques du Rhone has made the announcement that it will increase its capital from 3,200,000 f. to 21,600,000 f. by issuing 184,000 100-f. new shares. The company is now producing synthetic perfumes, pharmaceutical and other organic synthetic products. It has completely abandoned the manufacture of war-time products. (During the war this company produced 150 tons of phenol per day.)

Sales of chemically manufactured products have almost completely stopped and this is a source of great concern, especially to the Union des Producteurs et Consommateurs pour le Développement de l'Industrie des Matières Colorantes (Union of Producers and Consumers for the Development of the Dye Industry in France). This union, which was created to serve as a go-between for producers and consumers, bought in Germany soon after the armistice was signed practically all the dyes it could find on the market, but it cannot sell them, so that now it has vast quantities of dyes in stock waiting for buyers.

The French Government is trying by every means at its disposal to encourage the national chemical industry and to counteract the flooding of the French market with German chemical products. The best the government could do was to treble the import tariff for the greater part of the intermediates derived from coal tar. The list of these products which are now subjected to the new tariff was published in the Jan. 14, 1921, number of the *Journal Official*. The impression which prevails among the French chemical producers and especially among the dye manufacturers is that the aim of this new tariff schedule is to give to the national industry an opportunity to develop and to demonstrate whether it can resist foreign competition and subsist.

SITUATION OF THE FRENCH METALLURGICAL INDUSTRY

The Comptoir Métallurgique de Longwy, which for the last forty-five years has controlled the market of French phosphoric pig iron, was dissolved on Feb. 1, 1921. This comptoir, which comprised twenty French metallurgical companies, was forced to cease its operations due to its inability for some time past to exercise on the market a regulating and stabilizing influence as in former years and which was its *raison d'être*. This is due especially to the strong influence exercised by the new Lorraine companies, which possess great producing capacities and have yet vast quantities in stock, thus enabling them to flood the French market with their products. To this is also to be added the continuous inflow of Belgian and Great Duchy of Luxembourg products, which can be placed on the French market at prices far more advantageous than those asked for the French products.

Negotiations are now going on for the creation of a combination of French, Belgian and Luxembourg producers; it is expected that if such a combination is formed it will result in the elimination of an abnormal competition system and will put a stop to the policy of price cutting beyond reasonable limits.

FRENCH OIL SHALE

The increasing demand for oil and the continuous increase in its cost contribute to a serious consideration of giving an impetus to the French shale oil industry. Although France has extensive deposits of oil shale, especially around Bussières and Autun, very little attention has been given to this important material and at present there is only one oil shale-distilling plant of importance in all France. This plant is situated at Seyssel (Department of Ain) and produces annually about 100,000 hl. of oil (about 2,500,000 gal.), necessitating the treatment of about 200,000 tons of shale. The Scotch type of retorts has gradually displaced the older iron vertical retorts. The density of the oil is between 0.870 and 0.900; it contains about 5 per cent light oils of 0.730 to 0.750 density and about 30 per cent of oil of 0.810 to 0.850 density, the remainder being heavy oil used generally for manufacturing oil gas; the coke residue amounts to about 2.7 per cent. The greater part of the 0.850-density oil is used for lighting and a small part of the 0.875-density oil serves as a solvent for the extraction of alkaloids from quinine. The gas is used partly under the retort and the remainder, after washing and purifying, is used for lighting. In addition the Seyssel plant is producing about 10 lb. of ammonium sulphate per ton of shale treated.

The oil-shale industry, which up to 1914 subsisted only with difficulty, has since then grown steadily, and it is expected that in the near future the production will be trebled. Plans are now under consideration for the development of the French oil-shale deposits.

Swain's Report on Smoke in Salt Lake Valley

Summary of Field Conditions Surrounding Murray and Midvale Smelters and the Resulting Effect on Plant and Human Life — Notes on Operating Conditions Giving Immunity From Damage and Difficulties in Stipulating Maintenance Without Hampering Progress

IT MAY be recollected that during February, 1920, Federal Judge Johnson decided a smoke suit against the American Smelting & Refining Co. and the United States Smelting, Refining & Mining Co., allowing their smelters at Murray and Midvale respectively to continue operations under certain conditions and under observation of a staff headed by Prof. R. E. Swain of Leland Stanford University.[1] Prof. Swain, acting as commissioner, was to report his findings to the Judge after one year, this report to form a basis of a permanent stipulation as to methods of smelter operation whereby no nuisance or damage in the surrounding country would result.

After a year's research by eight assistants the commissioner has presented an exhaustive report, containing about 500 typewritten pages and many plates and photographs. A summary of his conclusions of general interest follows:

Conditions at Murray

The evidence appears to be conclusive that the plant of the American Smelting & Refining Co. at Murray was not at any time during the period of this investigation an agent of injury to crops or to vegetation of any kind, or the cause of personal discomfort or ill-health to the residents of that district.

Dr. Pool was in residence here without interruption from May 3 to Sept. 8. It is his expressed opinion that there was no damage whatever by sulphur dioxide even to the extent of questionable foliar markings on the most sensitive plants in the Murray district during the period of his residence here. My own observations are in entire agreement with those of Dr. Pool.

Concentration Dangerous to Plant Life

A study of the record of the atmospheric analyses made on the Murray smoke stream reveals no series of consecutive determinations, nor any average concentration for an hour or more, at any point in that district which, under critical weather conditions, would give rise to undoubted injury to sensitive vegetation. During the growing season—from May 2 to Oct. 19—4,386 determinations of sulphur dioxide were made on the air of this district at locations which were as nearly as possible in the line of movement of the roaster stack gases. When proper allowance is made for the probable analytical error in the method employed as determined by the control tests which were made at intervals during the investigation, none of these determinations shows an hourly average of more than one part per million. Even under weather conditions most favorable to sulphur dioxide action on the more sensitive crops, injury may not be expected to arise from any maximum hourly average obtained in this field. Owing to the changeable character of the wind in this section, it rarely happened that a series of determinations could be continued at one station for more than one hour with any reasonable expectation of getting positive results.

It is now generally conceded that a concentration of at least one part per million over a period of three hours is necessary to produce undoubted injury to the more sensitive crops. It will require a concentration of at least 1.3 parts per million if the period of fumigation were reduced to one hour. From either viewpoint, there is not in this record, even in the highest hourly averages found and an assumed coincidence of critical weather conditions, any proof that the more sensitive crops of the Murray district were subject to injurious action by sulphur dioxide at any time during the season of 1920.

Concentration Causing Nuisance to Humans

The question of whether the waste products discharged from the exit stacks of the Murray plant are injurious to the health or a substantial menace to the comfort and happiness of the residents of the district must be approached from another direction. Fortunately, reliable scientific data are at hand, as a result particularly of the work of the Selby Smelter Commission, bearing on the subject of the local and immediate physiological reactions which are induced by the breathing of air containing sulphur dioxide. The average human adult, who is already acquainted with the odor of this gas, will first be able to detect it at a concentration of 3 to 3.5 parts per million.

The average person not well acquainted with the smell could detect the gas at a concentration of from 4 to 5 parts per million. Above 5 parts the presence of the gas is increasingly apparent until at 10 parts per million the action is usually sufficient to cause most subjects to feel slight discomfort or to cough. Further results of that study, based on observations made on sixty subjects, are that occasional short whiffs of less than 5 parts per million certainly could not be considered a nuisance to anyone; long-continued breathing of air containing slightly more than 5 parts per million would probably cause discomfort to most people, although occasional momentary whiffs of 5 to 10 parts per million would not be disagreeable; and a few breaths of 10 parts per million would probably be called a nuisance by most people, even if this were present only at considerable intervals.

A survey of the entire record of atmospheric tests in the Murray district, amounting to 5,923 single determinations, shows that only nineteen of these represent a concentration of 3 parts or more per million, and only one a concentration of 6 parts per million. The highest concentration ever found in this district was 7.6 parts per million. These higher readings were in all cases preceded and followed by much lower readings. In

[1] See "Smoke Litigation in Salt Lake Valley," CHEM. & MET. ENG., vol. 22, p. 1145, June 23, 1920.

other words, they represent momentary "puffs" of smoke, running much higher in sulphur dioxide, which are occasionally noted especially on days of gusty winds. No other conclusion is possible than that the concentrations of sulphur dioxide which occurred in the Murray district during the period of this investigation could not possibly be regarded as a nuisance or an actual cause of notable physical irritation or discomfort to the residents.

Ground Gas

The contamination of the air in the immediate neighborhood of the plant through leakage of sulphur dioxide from furnaces and flue systems is relatively slight. These so-called "ground gases" or "low-down gases" have often been the cause of justifiable serious complaint by persons residing very near to smelters in other sections of the country. Certain of the older types of roasting furnace were especially hard to control in this respect, back drafts would often occur, and high concentrations of sulphur dioxide would escape directly into the air at the ground level. Although often of high concentration, these low-down gases, with furnaces of modern design, as a rule represent small volumes and rarely travel far from the point of discharge at an objectionable concentration, owing to the rapid absorption of the sulphur dioxide by the soil. At both of the plants concerned in this investigation precautions have been taken to prevent the discharge of furnace gases except through the exit stacks.

Both plants employ the Dwight-Lloyd and the Wedge type of roasting furnaces. The amount of leakage from these furnaces is small, owing to their construction and to the good draft maintained, and the products of combustion are swept away under induced draft into the main flue system. The blast-furnace building at each plant is well ventilated, and points where objectionable waste products may escape are hooded and the emanations are swept out into the ventilating flue.[2] At the Murray plant the ventilating flue leads to a large brick settling flue where the velocity of the gases is very low, and finally enters the roaster flue near the base of the 455-ft. stack. At the Midvale plant the ventilating gases are conducted to a small bag house, filtered to remove suspended solids, and thence discharged into the air. There is a small loss of sulphur dioxide from the bag house at each plant, especially during shakedown and other periods. This is greatest at Midvale, in the roaster section of the bag house, where the concentration of the sulphur dioxide is (0.70 to 0.85 per cent) much higher than it is in the section which handles the blast-furnace gases (0.01 to 0.05 per cent sulphur dioxide).

Lead and Arsenic Losses

The results of the filtration tests at the Murray plant point to an average daily loss from roasting operations through the 455-ft. stack of approximately 90 lb. of lead and 120 lb. of arsenic. These figures are probably fairly representative of the efficiency of the Cottrell process of electrical precipitation, with only two units in operation at one time. There is no evidence that the above losses of lead and arsenic are objectionable. The amounts of arsenic found in the vegetation of nearlying areas are small, and even these are undoubtedly due in part to the prevalent arsenic in the soils of the valley.

Precise Experiments on Soot Fall

It was our intention to find out much more accurately than would be possible from the analyses of plant samples what the actual atmospheric precipitation of arsenic and lead is in this valley by collecting snow samples by skimming the surface at various locations to a depth of ½ in. over an area of 25 sq.ft. after a heavy snowfall. Then at as long an interval as possible thereafter without the interference of thawing or another snowfall it was planned to make a second collection of samples. The difference in the arsenic and lead in the control and the ensuing test samples would give a fair basis for estimating the amounts of these substances which are thrown into the air by industrial establishments and residential coal burning. With the country blanketed by snow, soil dust would be excluded quite perfectly. By studying the result in relation to wind prevalency and velocity it was hoped that data of real value would thereby be secured.

Unfortunately, there has been no time this winter when a fall of snow has not been followed within twenty-four hours either by another snowfall or by a rapid thaw. It was planned early in the investigation to expose vaselined plates at various stations as a means of approach to this question, but this was abandoned in view of the fact that wind-swept dust from the soil could not be excluded by this proposed method.

But even in the absence of more exact data than those based on the analyses of exposed vegetation, there can be no reasonable cause for concern over the discharge into the open atmosphere, at a considerable height, of the above amounts of arsenic and lead in such a state of extremely fine division as these escaping dusts represent. I am confirmed in this conclusion by an experience with another smelter from which the stack loss of arsenic amounted to approximately thirty tons per day, and with several cement plants from which, before remedial measures were installed, dust in amounts ranging as high as sixty to seventy tons per day was lost.

Conditions at Midvale

The results of the investigation lead to the unavoidable judgment that the Midvale plant has been at times during the past season, and under present conditions and methods of operation may continue to be, an agent of injury to the vegetation of the neighboring district. The conclusions reached by Dr. Pool are clear on this point. The "burns" reported by him in the Christensen, Lemich, Turner and Norvich cases were called to my attention by Dr. Pool and gone over carefully by us together. Thus in these cases my confidence in his judgment is supplemented by my own observations.

The work done by the chemists on the Midvale "smoke stream" also is indicative of a dangerous condition. Out of the 4,311 single determinations of sulphur dioxide made during the growing season, there was an average concentration of 0.49 part per million. There were twenty-eight determinations of 6 parts or more per million, the highest single determination made being 19.4 parts. There were four determinations over

[2] See "Tapping-floor Ventilators," CHEM. & MET. ENG., vol. 21, p. 118, Aug. 1, 1919.

10 parts per million; 153 over 3 parts per million; and 438 over 1 part per million. The highest hourly average recorded was 2.78 parts per million, there being thirty-four hourly averages giving over 1 part per million by analysis.

It cannot be denied that the more sensitive crops cannot, under weather conditions favorable to sulphur dioxide action, endure such concentrations as have been found in this field. On the other hand, the results hardly justify the finding that the sulphur dioxide in the gas stream from the Midvale plant is the cause of actual discomfort to the residents of the district. There were momentary concentrations sufficient to cause coughing and local irritation, but only four determinations in all the time spent in the gas stream making tests were above 10 parts.

All results on filtration tests at the Midvale plant point to the efficient operation of the bag house units through which all flue gases are passed. The average daily loss in lead and arsenic is certainly too small to be a source of any possible injury to the animal life of the district.

Remedial Steps

It is my belief that steps should be taken by the United States Smelting, Refining & Mining Co. as soon as possible to improve the situation in regard to atmospheric concentrations of sulphur dioxide during the season of plant growth. The best means for accomplishing this end, in my opinion, lies in increasing the temperature of the roaster gases before their discharge into the air. No measure approaches this one in relieving an unfavorable field condition. I believe that a solution of the matter at the Midvale plant may be found without going to the expense of the suggested erection of a 450-ft. stack in addition to heating the gases.

Safe Operating Conditions

It is my firm opinion that if the Murray plant is continued under skillful management, if attention is paid to keeping the bag house and the Cottrell plant at their highest practical efficiency, and if the general operating conditions which prevailed during 1920 are maintained, the plant will be able to operate hereafter without being an agent of injury to its neighbors. But the fact should not be overlooked that the very favorable record of the past year is in all probability due to a number of important contributing factors, most of which fortunately involve no more than the continued intelligent and consistent use of operative measures which are already at hand and a part of the routine normal operation of the plant.

The operative measures which should receive attention are:

1. The bag-filtration of the blast-furnace gases.
2. The electrical precipitation of roaster dusts and other suspended solids by means of the Cottrell installation, two of the three units of which have been in regular operation.
3. The discharge of the roaster gases, which carry the highest concentrations of sulphur dioxide, at a temperature high above that of the outside air. During the dormant season for plants the temperature of these roaster gases was increased, and incidentally their volume as well, by the delivery of the boiler gases from a neighboring power house directly into the main exit stack. During the season of plant growth the gases were heated by means of coal furnaces near the base of the stack.
4. The discharge of the gases from roasting operations from a high stack at a point approximately 455 ft. above the ground level.
5. A maximum daily elimination of sulphur from roasting operations amounting to about 100 tons.

Industrial plants such as this are complicated and sensitive organisms. They will not run themselves. Their successful operation from the standpoint of a high recovery of metal at a low cost of production requires that painstaking attention be paid to all factors which have to do with the efficiency and cost of smelting operations. The situation is not now different in regard to smelter operation in relation to smoke injury. With the recent development of remedial measures having to do with plant operation a new responsibility has been thrust upon the operating staff, a responsibility which calls for no less skillful and painstaking attention on their part.

It can scarcely be denied that this plant is a potential agent of injury. Allow the filtration bags to deteriorate, reduce the voltage in the Cottrell plant, neglect the measures which have to do with maintaining a relatively high temperature in the exit gases, and a discharge of lead and arsenic in objectionable amounts or of sulphur dioxide under conditions of concentration and temperature which could give rise to serious injury to crops might easily result.

Guarantees and Restrictions

At once the question arises of what reasonable guarantees should be exacted, or what operating restrictions or other stipulations imposed to insure the indefinite continuance of safe operation. At first thought it would not appear unreasonable, with a plan of plant operation of proved safety before us, to make this the basis of future operation. This should at once give adequate protection to the residents of this community, but it has several serious objections. In the first place, as has been pointed out, there are many phases of plant operation involved as contributing factors to the present condition of immunity from damage. These are not so much independent as they are interdependent.

Thus it is no longer wholly logical, as a single measure of protection, to place a restriction on the amount of sulphur eliminated or the tonnage of ore roasted when it is known that by a suitable change in one or more other factors, such as the temperature of the exit gases, double that amount might be eliminated with even greater assurance of immunity from trouble. Accordingly, if stipulations are drawn up along the line of plant operation, they must deal not with one but with a number of factors and to that extent be more or less complicated. There is another objection to this proposal which is more serious. These are days of industrial progress based largely upon a new relation between science and industry. Rule-of-thumb methods are yielding to more intelligent and progressive direction. A set of stipulations dealing with plant operation, such as mentioned above, are at once a barrier to progress. Until changed, they may be just as effective in preventing the introduction of improved methods of operation as they are in preventing a relapse into a condition which makes plant operation a menace to the community.

Phosphoric Acid Evaporation

Description of a New Method for the Evaporation of Phosphoric Acid Without the Formation of Scale in the Apparatus During Operation—Accomplished Without Raising the Temperature of Liquid to Ebullition Point

By H. E. LABOUR

THE early manufacturer of phosphoric acid used bone char or its equivalent as a source of phosphate supply. The phosphoric acid was readily extracted from this material and the process of purification was simple. In order to concentrate phosphoric acid made from bone, ordinary steam-jacketed kettles or open pans were most commonly used, and aside from the necessity of properly protecting against the corrosive action of the acid itself, very little trouble was encountered. The acid carried only a small amount of scale-forming material and the volatile impurities were not so annoying that evaporation could not be carried on safely in an ordinary plant.

The supply of bone char did not increase in proportion to the demand for phosphoric acid and phosphates, and this led to the use of phosphate rock as a substitute source of supply. The purification of phosphoric acid as made from rock brought in different and much more difficult problems than were encountered when bone was used. Impurities were introduced into the acid which required elaborate and careful means for removal, and in the process of removing these impurities it frequently happened that others were introduced so that the liquid, by the time it was ready for concentration, carried a very high percentage of scale-forming material, as well as highly corrosive volatile materials, the most troublesome of the latter being fluorine.

Up to the time of the active production of double superphosphate, the difficulties already mentioned were mostly those encountered by manufacturers of food phosphates, and as the production of the material was limited in this country to a few concerns, the problem of evaporation of phosphoric acid was not given the thought and attention which it should have received.

Difficulties Encountered in the Use of Common Types of Evaporators

As soon as the fertilizer manufacturer attempted to concentrate his phosphoric acid, he found that the evaporation constituted a real problem, and many different methods were proposed and tried for this work. The vacuum evaporator was early given consideration due to its high economy of operation, but two distinct troubles were encountered which were never satisfactorily overcome. The first of these was the kind of material to be used for the parts coming in contact with the acid or the vapors. About the only metal which successfully withstood the acid was lead, and to make the matter still more serious, lead had to be used for all of the vapor fittings also, on account of the liberation of fluorine during evaporation. Even assuming that these difficulties could have been overcome, the second problem would have made the use of a vacuum evaporator entirely out of the question. The acid as delivered to the evaporater carried in solution a very high percentage of scale-forming materials such as calcium sulphate, and as soon as concentration began these were deposited on the heating pipes or surfaces and would sometimes build up to as much as ¾ in. thick in the course of a 12-hr. run. This heavy scale materially reduced the economy of operation and introduced the frequent cleaning factor, making the vacuum evaporator an impracticable unit for this work.

Various atmospheric methods of evaporation were also in service, such as troughs or pans having submerged steam pipes, or which were heated by hot gases, or even direct fire. These had the advantage of simplicity, but were low in economy, and the scale-forming trouble was always present.

Much work has also been done in connection with the use of towers, both packed and open. The packed tower gives a much better distribution of acid and of the hot gases, but the packing accumulates scale and sludge pockets, and the tower requires frequent cleaning. Furthermore, if hot gases are used as the means of evaporation, an entirely different trouble is encountered—namely, the formation of metaphosphate, which hangs up on the packing and tower walls as a rather sticky material. The sludge from the upper part of the tower gradually works down and accumulates with the metaphosphate formation until finally a hard, tough coating is formed. This is extremely difficult to remove, and of course the metaphosphate represents an actual loss. The open tower had the advantage of offering less surface for accumulation of sludge or scale, but the metaphosphate was still formed and frequent shut-downs resulted.

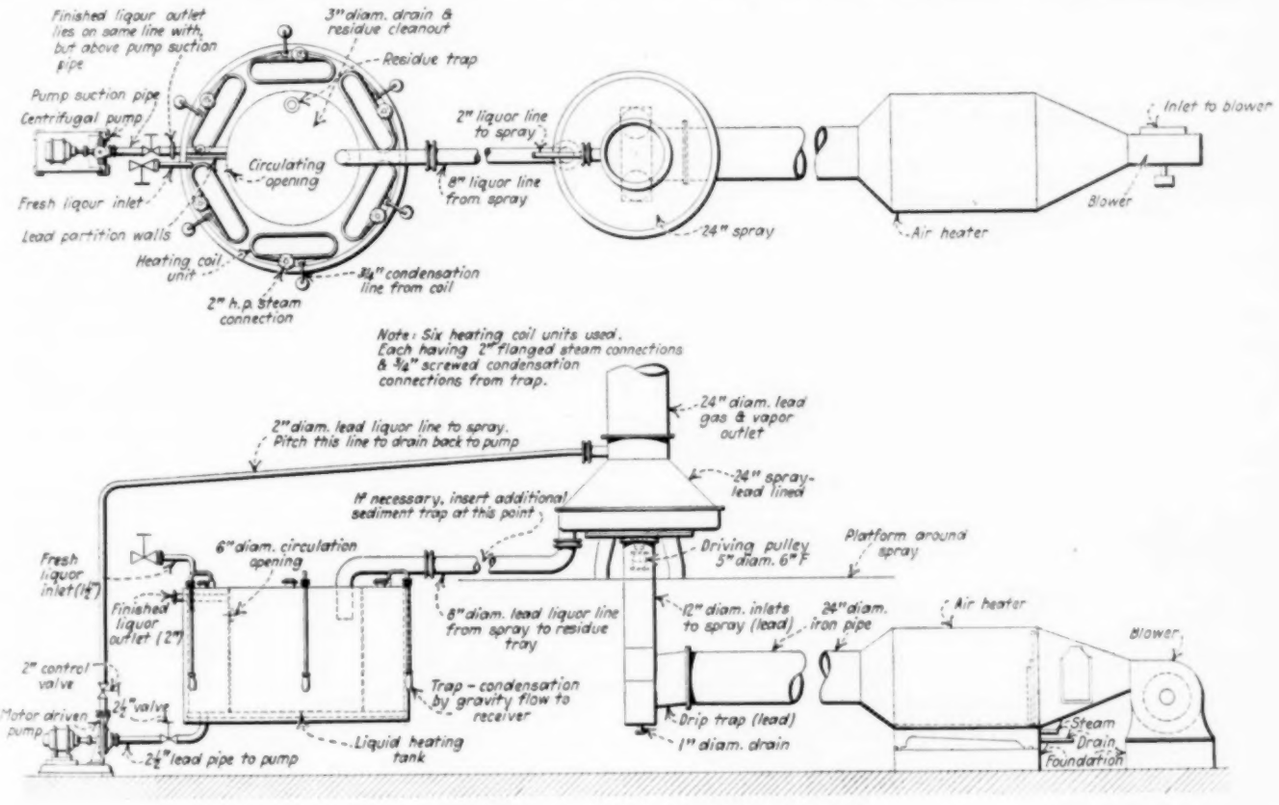
Spray Evaporating System

In studying this problem, the writer decided that in order satisfactorily to solve the problem of construction materials, it would be necessary to make the evaporating unit of as small dimensions as possible, especially those parts coming in contact with the acid, and, to reduce the corrosion difficulties as well as to eliminate the chance of formation of metaphosphate, evaporation should be carried on without raising the temperature of the liquid to ebullition point. It was recognized that it would be perfectly safe to heat the liquid to some temperature below that producing ebullition and still get no scale formation, as it was quite obvious that the scale formation was due to the deposition of sludge on the heating surfaces, and formation of the sludge was in turn due to the concentration of the acid. If, then, the acid was merely heated and not evaporated by contact with hot surfaces, there would be nothing to cause the formation of scale. If part of the heat that had been introduced into the acid could be utilized converting it into latent heat of

vaporization, out of contact with any heated surface, the scale-forming materials should come down as a sludge and should wash out with the acid as long as the whole body of material was kept in motion.

The use of a spray machine producing spray by throwing the liquid from the surface of a revolving disk seemed ideally adapted to this work, and experiments were carried on to determine the feasibility of the process. The experiments were successful, and the process has now been thoroughly worked out.

The accompanying drawing shows the general arrangement used in this method of evaporation. A heating tank having two concentric compartments is used. The outer or annular one of these has a partition which converts it into a circular trough, and in this outer compartment are placed steam coils. The weak acid is delivered to this circular trough on one side of and immediately adjacent to the dividing partition, and also on this same side of the partition is a large


Finished liquor outlet lies on same line with, but above pump suction pipe
3" diam. drain & residue cleanout
Residue trap
Pump suction pipe
Centrifugal pump
2" liquor line to spray
Inlet to blower
Circulating opening
8" liquor line from spray
Fresh liquor inlet
Lead partition walls
24" spray
Air heater
Blower
Heating coil unit
¾" condensation line from coil
2" h.p. steam connection
Note: Six heating coil units used. Each having 2" flanged steam connections & ¾" screwed condensation connections from trap.
24" diam. lead gas & vapor outlet
2" diam. lead liquor line to spray. Pitch this line to drain back to pump
24" spray-lead lined
If necessary, insert additional sediment trap at this point
Driving pulley 5" diam. 6" F
Platform around spray
6" diam. circulation opening
Fresh liquor inlet (1½")
Finished liquor outlet (2")
8" diam. lead liquor line from spray to residue tray
12" diam. inlets to spray (lead)
24" diam. iron pipe
Air heater
Blower
2" control valve
2½" valve
Trap - condensation by gravity flow to receiver
Motor driven pump
Drip trap (lead)
Steam
Drain
Foundation
Liquid heating tank
2½" lead pipe to pump
1" diam. drain

PHOSPHORIC ACID UNIT EVAPORATOR

submerged communicating opening between the inner and outer compartments. The weak acid, together with a certain amount of strong acid from the inner compartment, flows around this circular trough and is heated to the required temperature. On the opposite side of the dividing partition from that on which the weak acid is delivered is a large outlet at the bottom, and connected to this is a centrifugal pump. This pump draws the hot acid at the required rate and delivers it to the spray machine. Here the acid is thoroughly atomized and brought into contact with conditioned air. Evaporation of water takes place, the air in passing out carrying away the water vapor together with practically all of the fluorine content, and the concentrated acid passes out from the bottom of the machine to the center compartment of the heating tank. The temperature of the ingoing and outgoing air is practically the same, the only difference being in the relative humidity. The latent heat of vaporization is supplied by the acid and the temperature of the exit acid is consequently considerably below that at which it entered the spray machine. Also the scale-forming material comes down as a sludge, and having no hot surfaces on which to cling is washed out of the spray machine and is carried along with the acid. If the amount of scale-forming material is particularly heavy, a settling trap should be introduced between the machine and the center compartment of the heating tank.

The center compartment of the heating tank is also provided with an overflow pipe at the maximum liquid level and a portion of the finished acid is discharged from this constantly; the volume of this discharge being, of course, a factor of the volume of weak acid supplied and the amount of water evaporated. The remaining and greatest bulk of the acid delivered to the center compartment passes through the communicating opening between the two tanks, and joining the weak acid, is again passed through the spray. The function of recirculating this large volume is twofold: first, to supply sufficient heat units for evaporation, and second, to insure the elimination of fluorine.

A standard size unit is used. This size is ordinarily rated in terms of the number of pounds of water it will evaporate per minute from the acid. This rating usually remains unchanged regardless of the initial or final strengths of the acid to be handled.

As an example of the operation of this equipment, assume a weak acid of 19 deg. Bé. to be concentrated to 40 deg. Bé. Also assume a desired rate of evaporation of 35 lb. of water per minute. Deliver to the spray 150 gal. per minute of acid at approximately 40 deg. Bé., and at a temperature of 220 deg. F. allowing for radiation losses, the temperature drop will be approximately 38.6

deg. F., or the exit temperature of the acid will be approximately 181.4 deg. F. Assuming that air fully saturated at 160 deg. F. will carry the proper amount of moisture when the exit volume of the gas mixture equals 3,000 cu.ft. per minute, then allowance must be made for an actual exit temperature of something in excess of 160 deg. F. on account of the partial vapor pressures existing in the system. In this case the actual exit temperature would have to be in the neighborhood of 175 deg. F. In order to insure maximum evaporation with a minimum time of contact, it is advisable to preheat the relatively dry incoming air to approximately the same temperature as that at which it will leave the spray.

Assuming that the rate of feed of weak liquor to the heating tank is approximately 10 gal. per minute, and the rate of delivery to the spray is 150 gal. per minute, then the remaining 140 gal. per minute must be recirculated and delivered to the heating compartment from the inner or settling compartment. This 150 gal. per minute would pass to the spray, where there would be, roughly, 4 gal. per minute of water removed, and 146 gal. per minute of concentrated acid returned to the center compartment of the heating tank. Since only 140 gal. of this has to be recirculated, the remaining 6 gal. would pass off from the overflow pipe as finished product. It will be noted that any change in the rate of feed of weak liquor will automatically change the rate of exit of finished liquor, and consequently the concentration, so that the entire control of the apparatus once it is in operation is carried on by means of the valve controlling the supply of weak liquor.

If all power, both steam and mechanical, be converted to a steam basis with the best of the pan or submerged type of evaporators 1 lb. of steam will evaporate only approximately 0.5 lb. of water and as the scale formation increases even this rate of evaporation is reduced. With the spray evaporator radiation losses are materially reduced and the heat transfer is handled in a much more efficient manner; consequently, the economy obtained is approximately 0.65 lb. of water evaporated per lb. of steam condensed. This economy of evaporation holds uniform, as scaling trouble is not encountered.

More Flakes

By Haakon Styri

IN THE issues of Chemical & Mettallurgical Engineering for April 1 and May 1, 1919, the writer discussed several types of flakes, their occurrence and possible elimination.

Recently a particular type of flake has come to the writer's notice of which there can hardly be any doubt as to the origin. We had found a number of flakes in a 4½-in. bar of high-carbon chromium steel and wanted to investigate this trouble further. For that purpose thirty-one disks about ¾ in. thick were cut from an annealed bar. All these disks were treated with gasoline containing fine grinding chips of steel. It was found that Nos. 1 to 17 inclusive contained cracks and that Nos. 18 to 31 inclusive did not reveal any.

Disks 11 to 15 inclusive were bent slightly and it was found that they contained more cracks than were found with gasoline treatment only.

By fracturing disks 16 and 17 it was found that the structure where the flakes opened was coarser and more crystalline than the surrounding normal material.

Disk 2 was examined microscopically where a crack had shown up with gasoline, but no crack could be found even under 1,000 magnifications after the piece had been polished and etched with 1 per cent nitric acid in alcohol, but the crack was revealed with deeper etching.

Two disks, 18 and 20, which had not shown cracks with the gasoline treatment, revealed cracks in bending.

Eighteen disks, 3 to 10 inclusive and 20 to 29 inclusive, were now hardened and thereafter fractured. All these showed flakes and in disks 3 to 10 inclusive they were found to correspond with the cracks located with gasoline before hardening. Some additional flakes also appeared. The structure of these flakes after fracturing had the same coarse crystalline appearance as the structure of the flakes found in bending the unhardened disks, but outside the flakes the structure was fine and silky.

Several streaks were found in the flakes, probably manganese sulphide, but sulphur prints did not reveal the presence of more sulphide in the flakes than other places in the fracture. Some of the flakes found extended through the whole thickness of the disks, even where no flakes had been located with the gasoline treatment, and were from ⅛ to ¼ in. long. All the flakes found were parallel to the direction of rolling, and were comparatively flat.

It seems evident that these flakes were produced during rolling and not by any heat-treatment of the bar.

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Philadelphia, Pa.

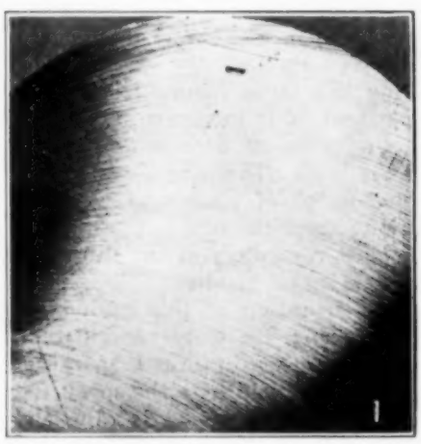

Fig. 1. Disk as cut from bar.

Fig. 2. Same as Fig. 1, magnetized.

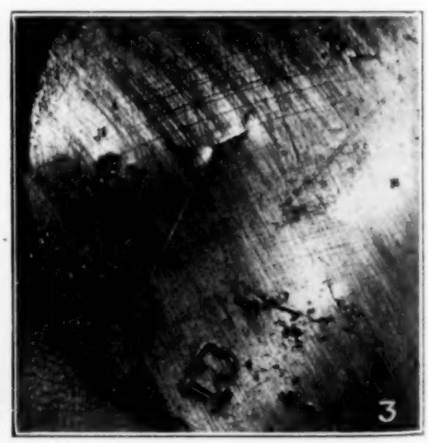

Fig. 3. Same as Fig. 2, slightly bent.

FIGS. 1 TO 3 (ABOUT ½ NATURAL SIZE)

Refinery Practice in Beet Sugar Manufacture

Description of Modern Practice in the Beet Sugar Refinery—Purification of the Diffused Juice by Precipitation of Lime Carbonate and Filtration—Evaporation in Vacuum Pans to Massecuite—Treatment of Sirup and Sugar

By WALLACE MONTGOMERY

THE first step in the sugar recovery process is to heat the raw juice. This is done with exhaust steam or vapors from the evaporators. The temperature of the juice entering the heaters is about 55 deg. C., depending, of course, upon the temperature carried in the battery. The juice leaving the heaters should not be less than 80 to 85 deg. C., as it has been found that the saturation of the juice with CO_2 is best carried on at about 80 deg. C. From the heaters the hot raw juice is pumped to what are known as carbonation tanks. The tanks may be of any shape, though the ones in general use have quite a slope in the bottom allowing free discharge. In the bottom of the tank is some form of distributor for the gas, either a perforated coil or a long box, inverted, with saw-tooth edges allowing the escape of the gas on all sides.

The raw or diffusion juice from the beets varies in quantity from 125 to 160 per cent on the weight of the beets and is of approximately the following composition:

Brix, deg	12.50	to	15.00
Specific gravity	1.0506	to	1.0613
Sugar, per cent	11.5	to	13.50
Purity	82.00	to	85.00
Ash, per cent	0.55	to	0.65

Purification of the Beet Juice

It is now essential that the juice be purified or defecated. This is accomplished by the addition of lime solution. In a factory not using the Steffens process of recovery of sugar from the waste molasses, milk of lime alone is added at carbonation, but in a factory that has a Steffens house in connection, the lime is added in the form of a lime-sugar combination or saccharate. The burning of the limestone is accomplished in large vertical kilns.

The hydrated burned lime reacts with the salts present in the juice and neutralizes any acids present. A heavy precipitate is formed upon addition of CO_2, and the lime is again converted into $CaCO_3$. As the precipitate settles out there is some mechanical purification.

In a refinery not using the Steffens system the addition of from 3 to 3.5 per cent of lime, based on the percentage of beets, is sufficient. In a Steffens house from 4 to 6 per cent is added, depending upon the speed of working and the impurities present. The control of the carbonation is of utmost importance. It is carried on until the juice has an alkalinity of from 0.085 to 0.110 g. CaO in 10 ml. This partly treated juice is again pumped through heaters, the temperature being raised to 90-95 deg. C., then pumped through some form of filter. In some factories the plate and frame type is used. Work is now being done on a continuous filter for this purpose and shortly it will be in use.

From the presses a clear liquid of light straw color is obtained. In the presses the precipitate, or lime cake, as it is called, remains. This cake contains considerable sugar, removed by washing with hot water. The quantity of cake varies with the process, but usually amounts to from 40 to 48 lb. per ton of beets sliced.

Wash water to the extent of from 30 to 40 per cent of the weight of the beets, lime approximately 4.5 per cent and CO_2 from 3 to 4.5 per cent is used, bringing the total volume of juice up to about 200 to 220 per cent on the weight of the beets.

From the first presses the juice goes through another heater and is raised to about 95 to 96 deg. C., precipitating any salts or combination of salts that are still present from the first saturation. From these heaters the juice is again filtered and then passes to the second carbonation or saturation tanks. Here the procedure is much the same as in the first carbonation, only no lime is added. The juice is gassed until it contains only 0.025 to 0.030 g. CaO per 10 ml.

Inversion Reduced to Minimum

The addition of a solution of soda ash here has been found beneficial in further reducing the lime salts present in the juices. Soda added up to 2 lb. per ton of beets worked will be found beneficial, though an excess will tend to increase the inert sugar content. In all cases the amount should be strictly governed by determining the lime salts present by titration with standard soap solution and holding the juice at 0.030 to 0.045 g. CaO per 100 ml.

Further heating and refiltration give a clear straw color juice, known as second carbonation juice. The addition of SO_2 is usually the next step. Here the alkalinity is reduced to approximately 0.010 to 0.012 g. CaO in 10 ml., after which the juice is filtered again, and the resulting juice, known as thin juice, amounts to approximately 220 to 240 per cent of beets and is of the following composition:

Brix, deg	12.0	to	14.0
Specific gravity	1.048	to	1.057
Sugar, per cent	10.00	to	12.00
Purity	85.0	to	88.0
Ash, per cent	0.85	to	1.15

The juice is now ready for evaporation, which is carried on under vacuum in multiple effect evaporators, of which there are numerous types and makes.

The juice is concentrated to from 55 to 60 deg. Brix and is sent to the melter to mix with the raw sugar or sent direct to heating tanks, heated, filtered and sent to vacuum pans, where crystallization is carried to completion.

Preparation of Thick Liquor

When the juice goes to the melter raw sugar amounting to from 4 to 6 per cent of the weight of the beets is added, making the thick juice amount to 46-48 per cent of the beet weight.

A further sulphuring is usually made here, reducing the alkalinity, which, due to concentration, is about 0.060 to 0.075 g. CaO to 10 ml., down to 0.010 to 0.012 g. CaO in 10 ml.

In a series of experiments by the writer the following results were obtained:

Sample	D.S. by Refract.	Color to 100 D.S.	CaO to 100 D.S.	Alk. to 100 D.S.	
1	63.0	60.2	0.206	0.216	Before SO_2
2	62.0	65.4	0.266	0.222	
1	63.0	40.0	0.119	0.013	After SO_2
2	62.05	50.8	0.129	0.032	

	Per Cent Reduction of Color	Per Cent Reduction of CaO
1	33.4	42.2
2	22.3	51.5

This shows that for reduction in color the alkalinity should be 0.010 to 0.012 g. CaO per 10 ml., but for greater reduction of lime salts 0.030 to 0.040 g. CaO per 10 ml. gave best results.

First Liquor

The evaporator thick juice, after having been mixed with raw sugar, is called first liquor and is approximately of the following composition:

Brix, deg	60	to	65
Specific gravity	1.289	to	1.319
Sugar, per cent	55	to	58
Purity	87	to	91

and amounts to 45 to 48 per cent on beets.

This liquor is sent to tanks known as blow-ups, which are nothing more than heating tanks. Here the temperature is raised to 95 to 98 deg. C. and kieselguhr is added at the rate of 0.50 to 0.75 lb. per ton of beets worked.

The kieselguhr acts as a filtering medium in the filter presses, through which the hot liquor is pumped.

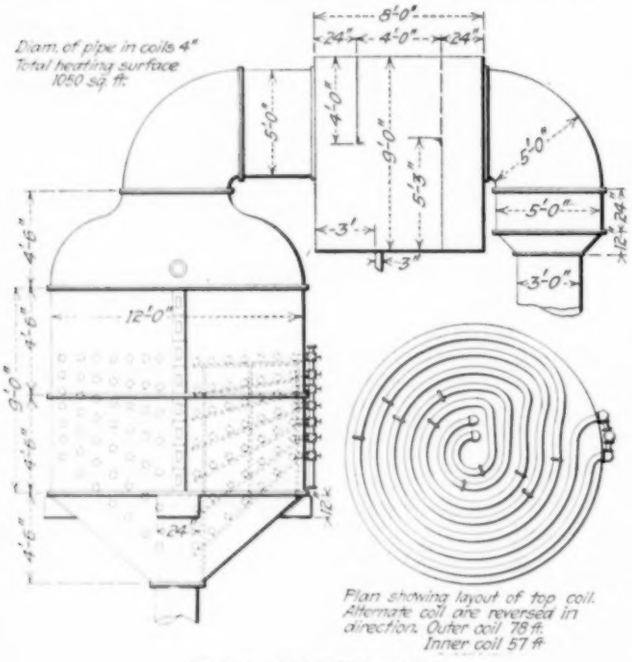

FIG. 1. VACUUM PANS

The resulting clear, light-colored liquid is now ready for graining. The graining is accomplished in vacuum pans. Fig. 1 shows one type. The proper control of the crystallization requires experienced operators or sugar boilers.

The principle of graining consists of evaporating the liquor or sirup until such a concentration is reached that the crystals of sugar form, after which more sirup is added and evaporation continued successively until the operator has finished the pan or strike.

There are many methods of graining a pan besides the above-mentioned, one of which is the adding of sugar powder or dust to the saturated or nearly super-

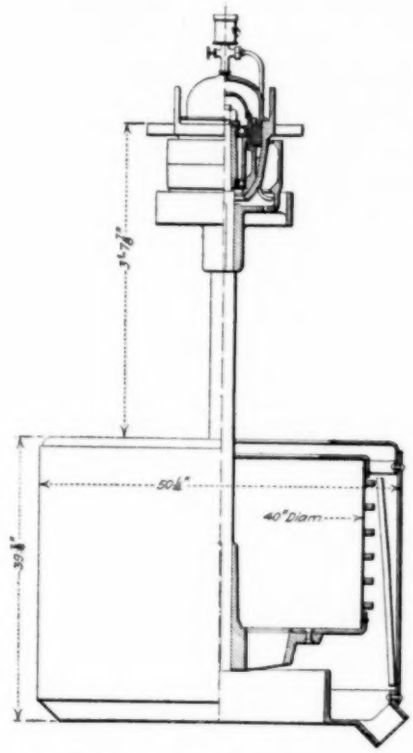

FIG. 2. CROSS-SECTION OF SUGAR CENTRIFUGAL

saturated solution. The point of supersaturation varies with the purity of the juice. A higher purity or purer juice will form crystals at a lower point of supersaturation than one of lower purity. By the sugar powder method a more uniform grain is formed, which means a higher yield and a slight saving in steam consumption, due to time gained in graining.

Massecuite Centrifuged

The sirup having been boiled to grain, the first massecuite, as the product of these first pans is called, is sent to the centrifugals. Fig. 2 shows a common type. The liquor coming off is called green sirup. This is the liquor that has not formed any grain in the pan while boiling the first strike. The purity of the green is about 72 to 75 and the quantity is approximately 22 to 25 per cent, based on beets worked; the massecuite amounts to approximately 46 to 50 per cent of the beets.

Some green sirup stays in the centrifugals with the crystals and later has to be washed out. This is where the wash sirup is obtained. In the case of very fine crystals the wash purity will probably go higher than the original purity of the pan on account of some of the grain dissolving. In a coarse grain strike there is less danger of this happening. So from the liquor originally boiled we have

	Purity
Green sirup	72 to 75
Wash sirup	84 to 89
Sugar	100

We still have the green and wash sirup to contend with. The wash is sent to blow-ups as was the first liquor, where it is heated, sulphured and filtered, though only 0.25 to 0.35 lb. of kieselguhr per ton beets worked is used on this sirup. The filtered solution is sent again to the pans, where it is drawn in with the first liquor and reboiled. The green is similarly treated, but being of such low purity it is impossible to make white sugar from it directly; therefore it is boiled separately and put in crystallizers, Fig. 3 showing the open type, where it is allowed to remain for 72 to 96 hours, in which time the size of the crystals increases, due to the cooling of the supersaturated solution. It is then centrifuged and we have a similar condition as with the first pans, although the purities are much lower, the green from the second pans or raw pans being 60 purity or less, while the wash water, only sufficient being added to remove the green, runs about 62 to 65 purity.

Steffens House

It would not be possible to use these liquors for the recovery of sugar in the pans, due to the amount of impurities present. If they were boiled blank—that is, concentrated almost to the point where crystals should form and then placed in tanks or crystallizers and

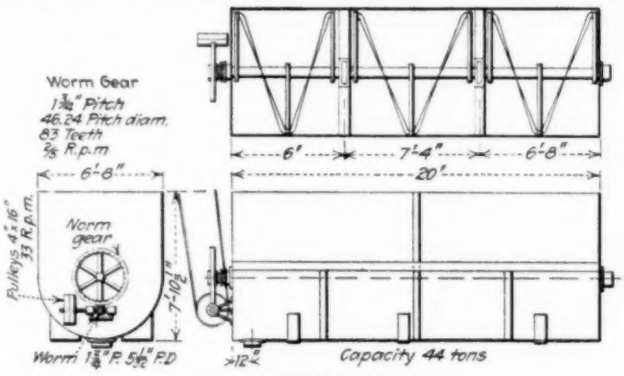

FIG. 3. CRYSTALLIZER

allowed to cool—grain would form, but the yield would be very low and the sugar of low purity. Therefore these final sirups, low green and low wash, are sent to the Steffens house for the recovery of sugar from the molasses by another method. This process will be taken up in another article later on.

Drying the Granulated Sugar

The white sugar from the centrifugals, containing about 2.5 to 3.5 per cent moisture, is sent to driers or granulators, usually in two steps, one above the other. The sugar enters one end and as the drum revolves is worked toward the farther end, while hot air is pulled through the drum by means of an exhaust fan. Figs. 4 and 5 show in a general way this type of apparatus. From the granulators the sugar, containing about 0.10 to 0.15 per cent moisture, is bagged and ready for market. The raw sugar is melted and mixed with thick juices, as we have seen before.

Quantity and Quality Table

From the accompanying table some idea may be gained of the quantity and analysis of the products in the order of their appearance in the process. These figures are only approximate and vary considerably in some factories.

The term purity is best explained by an example. If we speak of a molasses of 60 purity we mean that 60

QUANTITY AND ANALYSIS OF PRODUCTS

Name	Per Cent on Beets	Brix, Deg.	Sugar, per Cent	Purity
Beets	100	.....	16–18	79–86
Diffusion juice	130–150	12.5–14.5	10–12	82–86
Saccharate milk	60–65	30–35	.....	84–89
Total lime used	4–6	.....	.....	.....
Juice of first carb	210–225	.....	.....	.....
Lime cake	20–25	.....	0.20–0.35	.....
Thin juice	225–250	12.5–14.0	10–12	85–89
Thick juice	40–44	55–65	50–54	85–89
First liquor to pans	45–48	58–65	52–55	86–91
First wash at high	18–22	60–65	50–55	82–88
First massecuite	48–50	92–95	78–82	86–90
White sugar	15.5–17.5	.....	99.7–99.85	100
First green or high green	20–25	60–65	48–52	73–76
Raw pans or second mass	15–18	95–97.5	64–70	73–76
Molasses (low green)	4.5–6.5	82–87	48–52	57–62
Molasses (low wash)	1.5–2.5	.....	.....	.....
Raw sugar	5–6	95–97	92–94	95–98

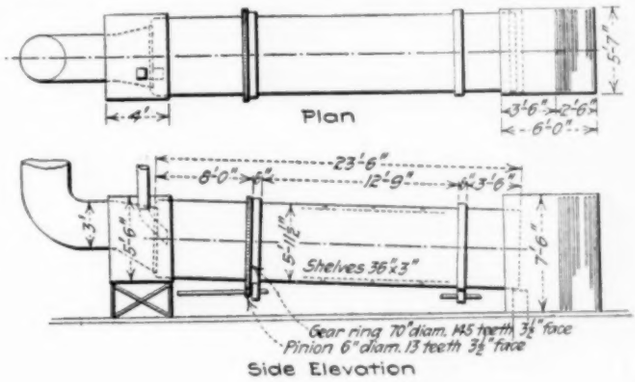

FIG. 4. SUGAR DRIER

per cent of the total solids in 100 lb. is sugar. By Brix we mean the per cent solids in the solution. Therefore sugar divided by Brix or solids equals purity.

Calculation of the Granulated Equivalent

To determine the amount of sugar recovered from the beets we must take stock of all products in the factory, measuring carefully all tanks and containers and sample each substance. Then by the following formulas we may calculate the amount of sugar to be expected from

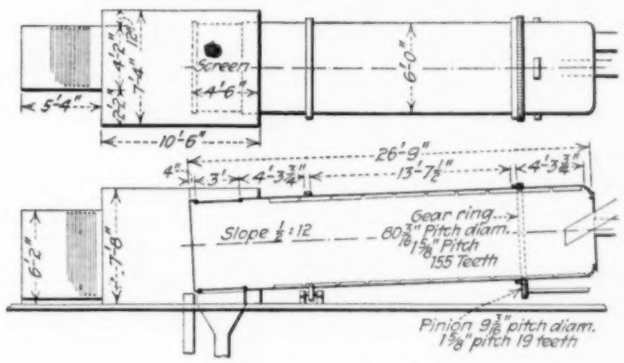

FIG. 5. GRANULATOR

the stock in house. This is called the granulated equivalent, or

(1) *Granulated equivalent = Pounds dry substance or solids* $\times \dfrac{\text{Average purity stock} - \text{Purity final molasses}}{100 - \text{Purity final molasses}}$

(2) *Sugar in molasses in stock = Total pounds sugar in stock — Sugar crystallizable or gran. equiv.*

(3) *Sugar recoverable in molasses in stock* $= \dfrac{70 \times \text{Pounds sugar in molasses in stock}}{100}$

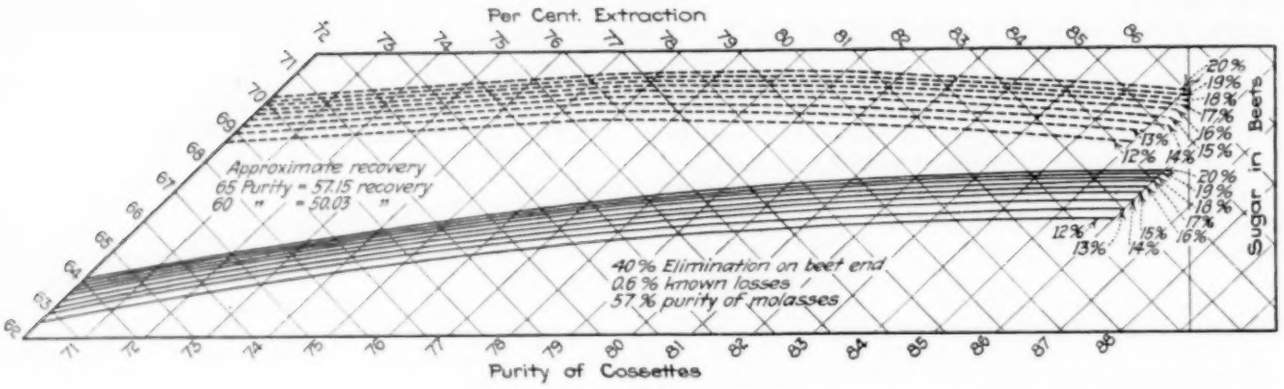

FIG. 6. EXTRACTION CHART

(4) *Sugar not recoverable in molasses in stock = Pounds sugar in molasses in stock — Pounds recoverable*

Items (1) and (3) = Total sugar in stock as granulated sugar.

Another formula for expected yield that gives results comparable to above is as follows:

$$\text{Per cent yield} = \frac{\text{Purity sugar (Purity of stock} - \text{Purity final molasses)}}{\text{Purity stock (Purity sugar} - \text{Purity final molasses)}}$$

Multiplying total sugar by percentage obtained gives sugar to be expected.

To calculate the yield from a pan or strike the following formula is used:

$$\text{Yield in per cent sugar} = \frac{M - G}{100 - G} \times 100 \div \frac{M}{100}$$

where M = purity massecuite
G = purity green sirup

This formula is of comparative value only as we assume sugar to be 100 purity and do not take into consideration the wash sirup. Likewise if we know the sugar content of the beet and purity we may calculate the yield by curves plotted on this basis and the assumption that total elimination beet end is 40 per cent, total known losses are 0.6 per cent, and purity of final molasses is 52 to 57 as shown by Fig. 6. This chart is applicable in a factory working only the sugar from the beets and shipping waste molasses. It does not apply to a factory having a Steffens house in connection.

The results obtained by the use of this chart will be found to check out very closely with actual work in the factory.

Fig. 6 is produced with one-fifth the scale used in a works drawing, with tenths deleted.

Union Sugar Co.
Betteravia, Cal.

Draft of British Home Office Regulations for Chemical Works

Regulations applying to a wide variety of chemical processes and plants have been drafted by the British Home Office and published so that possible objections might be raised.[1] These new regulations will supersede the Special Rules for Chemical Works first established in 1894, regulations made Dec. 30, 1908, for the manufacture of nitro and amido derivatives of benzene and those made Aug. 9, 1913, for the manufacture of sodium or potassium chromate and bichromate. The manufacture of white compounds of lead and red lead, orange lead or flaked litharge is covered by separate codes. Bleaching, dyeing, mercerizing, brewing, tanning, alcohol distillation and processes carried on only by way of experiment are also exempted.

It has been recognized that in certain classes of chemical works special dangers exist which are not found in other branches of the industry and for this reason the regulations are divided into two parts, the first of which is applicable to all chemical works as defined in the schedule and the second to those only in which special dangers need to be dealt with.

Part I, applying to all chemical works, covers such items as: Providing railings on low open kettles, etc.; using an efficient exhaust draught when drawing the charge from a salt cake furnace or from a pyrites kiln, slaking lime or where arsine may be generated; enclosing mills and screens for use with lime; equipping stills and autoclaves with safety valves. The remaining sixteen clauses are devoted to an elaborate set of hygienic measures covering mess and washing accommodation, ambulance and rescue equipment.

Part II applies to plants or parts thereof in which: Caustic pots are used; chlorate or bleaching powder is made; gas tar or coal tar is distilled or is used in any process of chemical manufacture; synthetic coloring matters or their intermediates are made; a nitro or amido process or a chrome process is carried on; shale oil is refined or used in a chemical process; nitric acid is used in making nitro compounds. In these cases the regulations relating to washing facilities are naturally more stringent and involve the supply of baths, nail brushes, soap, clean towels, etc. Protective clothing is also specified.

Certain of the hygienic features of the regulations have been criticized by the Association of British Chemical Manufacturers as being too extravagant and impracticable for introduction at a time when the financial position of the industry cannot bear the additional expense.[2] This is particularly true of some of the smaller and more recently established plants. While these precautions are generally recognized as absolutely essential in the manufacture of such irritants as dinitrochlorbenzene and TNT, it is feared that according to the schedule of processes included under Part II, it will be necessary to satisfy these provisions in many cases where they are not absolutely necessary. It is generally felt in the industry that had the collaboration of such a body as the above association been secured in the compilation of the regulations they would have been found more generally acceptable to all sections of the industry.

[1] Copies of this draft may be obtained from the Factory Department, Home Office, London, S. W. 1.

[2] See *J. Soc. Chem. Ind.*, vol. 40, p. 39R, Feb. 15, 1921.

Dust Explosions

Some Methods of Prevention of Dust Explosions—Engineering Problems Demanding Attention—Reduction of Atmospheric Oxygen Content Below Combustion-Supporting Mixture—Grounding Static Electricity

By DAVID J. PRICE
Engineer in Charge Grain Dust Explosion Investigations

IT IS now generally understood that disastrous dust explosions can occur in any industrial plant where combustible dusts are created during the operating processes. Experimental work has shown that a proper proportion of dust and air creates an explosive mixture which can readily be ignited by an external source of heat or flame. Although for some time the common causes such as open flames and matches have been accepted, the investigations of recent dust explosions and resulting fires have developed causes associated particularly with the mechanical and electrical equipment. Some of these causes relate to metallic sparks in grinding machinery and dust-collecting systems, especially in connection with the exhaust fans now in common use. Electrical causes such as broken incandescent lamp bulbs in dusty atmospheres and dust settling on the lamps have been new determinations. In addition it has been found that disastrous explosions have been caused by sparks of frictional or static electricity, and by dust ignition, resulting from the rubbing of pulleys and belts during choke-ups in elevator legs. The extent of these explosions, together with the losses caused by them, indicates the importance of the problem.

Methods of Prevention

The installation of efficient dust-collecting equipment is one of the most effective methods of controlling explosions of this nature. The accumulation of dust throughout the plant permits the propagation of flame from the time of the original ignition until the secondary or larger explosion occurs.

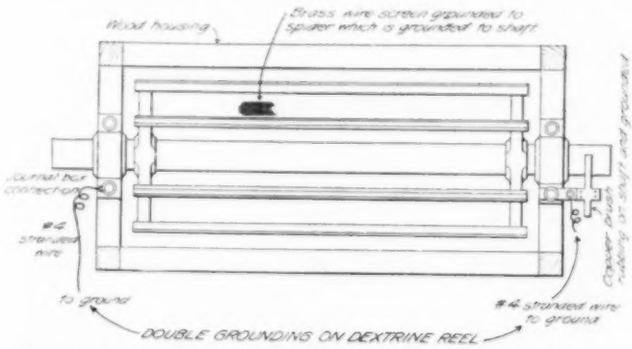
Wood housing
Brass wire screen grounded to spider which is grounded to shaft
Conduit box connections
#6 stranded wire
to ground
#4 stranded wire to ground
DOUBLE GROUNDING ON DEXTRINE REEL

FIG. 1. DOUBLE GROUNDING METHOD FOR CONDUCTING STATIC ELECTRICITY FROM DEXTRINE REELS

The elimination of open flames in dusty parts of the plant is of course very essential and should be rigidly practiced. The electrical equipment should be well protected and incandescent lamp bulbs located in dusty sections of the plant should be properly guarded. As a result of special experimental work with the lamp-manufacturing companies it is felt that vapor-proof globes would afford additional protection.

Attention should be given to the proper grounding of equipment where static electricity would be produced. This is essential in connection with pulleys, belts, grinding equipment, revolving reels and other similar types of machinery.

The entrance of foreign material into grinding machinery should be prevented by effective magnetic separators, or other devices now designed for this purpose. Special attention should be given to the prevention of choke-ups in elevator legs by systematic inspection during the operating periods.

Atmospheres of Low Oxygen Content

Some experimental work has already been carried on in an effort to maintain an atmosphere which would not support combustion by reducing the oxygen content in the atmosphere in places where dust-ladened air is unavoidable.[1] If, for instance, it was possible to maintain in a grinding machine an atmosphere which would not support combustion the dust would not ignite. The experiments conducted were for the purpose of determining to what amount the oxygen content of the air must be reduced in order to prevent propagation of flame in explosions of various kinds of dust.

The results of the tests indicate that an explosion of starch dust cannot occur in an atmosphere containing less than 12 per cent of oxygen. This limit can possibly be extended to 14 or 14½ per cent of oxygen if grain elevator dusts are considered. The maintaining of an atmosphere of inert gas in all systems grinding or handling carbonaceous materials which form dangerous dusts would, therefore, be an effective means of preventing many dust explosions. Even though an amount of dust ordinarily dangerous may be present and a spark or other source of heat may be formed, the dust would not be ignited nor an explosion be propagated, because the oxygen content of the atmosphere would be too low to support combustion.

Harger, in an article on "Coal Dust Explosion and Prevention"[2] states: "The only way absolutely to prevent dust explosions is to reduce the oxygen percentage below the lower limit, which varies with the different coal dusts. A reduction of 2 per cent will do for all mines, but to get a guarantee of absolute immunity 17½ per cent oxygen is the figure. A 17½ per cent oxygen atmosphere is ideal for a coal mine, if it is not too expensive to obtain, although this should not be the case."

The most easily secured inert gas around the plant is flue gas. Flue gas contains a large amount of nitrogen, 79 per cent, and the remaining 21 per cent consists of various amounts of carbon dioxide, oxygen and carbon monoxide. The results of the tests show that

[1] *J. Ind. Eng. Chem.*, vol. 9, p. 347, April, 1917.
[2] *J. Soc. Chem. Ind.*, vol. 31 (1912), p. 413.

FIG. 2. CONCRETE CONSTRUCTION WRECKED BY STARCH EXPLOSION

a lower oxygen content in the inert gas mixture is probably necessary to prevent an explosion of grain dust than would be required to prevent an explosion of coal dust. The results obtained with coal dust would indicate that a lower oxygen content in the mine atmosphere than that recommended by Harger would be necessary to prevent a coal dust explosion. However, a limit of 17½ per cent oxygen was very close to that determined in this work. As a result of the tests it has been determined that an inert gas mixture containing not over 12 per cent of oxygen will prevent a dust explosion from starting or propagating.

Inert Dust

Effective results have been obtained by the U. S. Bureau of Mines in the use of inert dusts, such as shale, limestone, etc., in preventing flame propagation. The mixture of inert dusts and air prevents the flame from propagating and has a "blanketing effect" much the same as the gauze or screen in the Davy safety lamp. Although only a limited amount of work has been done, it is felt that there is a possibility of inert dust being used in the prevention of dust explosions in mills and elevators under certain limited conditions.

It may be possible to design a method of introducing the inert dust into elevator or conveyor lines to prevent the spreading of flame from the original explosion. In numerous instances the explosion has traveled from the point of origin through the conveyor or elevator legs to bins of large capacity in which considerable dust was present. If a method of introducing inert dust could be perfected it would possibly prevent the propagation of flame and limit the explosion to small proportions.

Dust Removal

In connection with dust-collecting systems as now installed in our industrial plants recent investigations have indicated that a number of explosions were directly associated with the manner in which the exhaust fan was installed in the system. In one instance a disastrous explosion of aluminum dust was caused by a piece of wire entering the exhaust fan, causing six deaths and injury to a similar number of persons. In many instances exhaust fans are installed for the removal of fine dust from buffing or polishing wheels, grinding rolls and similar equipment. In these installations as a rule the fine dust is drawn from the source of production through pipe trunkings into the exhaust fan and then blown into the collecting device. In a number of recent disastrous explosions the origin has been associated with the exhaust fan.

In installations of this nature a flammable mixture is usually formed when the dust passes through the exhaust fan. Explosions may be caused by the ignition of the dust by sparks from foreign material striking the fan blades or from the fan blades becoming loose. This situation has suggested the possibility of changing the location of the fan from its present position—namely, between the source of dust production and collection—to a position beyond the collector. In other words, can the dust be drawn into rather than blown into the collector?

The Industrial Commission of Wisconsin has designed and installed in a factory in that state a system of primary and secondary air currents for dust removal.[3] The commission reports that tests demonstrating the practicability of the system have already been made.

Research Engineering Problems

In order to conduct a special educational campaign of dust explosion prevention both during the period of the war and until the expiration of the wheat guarantee act it was necessary for the Bureau of Chemistry to discontinue a number of the important lines of research work. Several problems are now presenting themselves for consideration indicating the necessity of further development before effective methods of prevention can be determined.

Although the laboratory and small-scale experiments have shown that the propagation of flame in dust explosions can be prevented by the use of "inert gases" it is necessary to determine definitely if it is commercially practicable to use installations of this nature. This will require further experimental engineering work relating to the securing of inert gases from the boiler flues and the developing of proper equipment for its introduction into grinding machines and milling equipment. This is a very important phase of the work, since a large number of explosions are continually occurring in plants where flammable dusts are produced during grinding operations.

In the construction of industrial plants consideration must be given to dust explosion prevention. The construction should be of such a type that dust cannot collect or settle in certain parts of the plant and thereby increase the explosion hazard.

Development of effective methods for the control or

[3] Chem. & Met. Eng., vol. 23, No. 19, p. 915, Nov. 10, 1920.

FIG. 3. BINS WITH "STEEL TROUGH-PLATE CONSTRUCTION" WRECKED BY DUST EXPLOSION

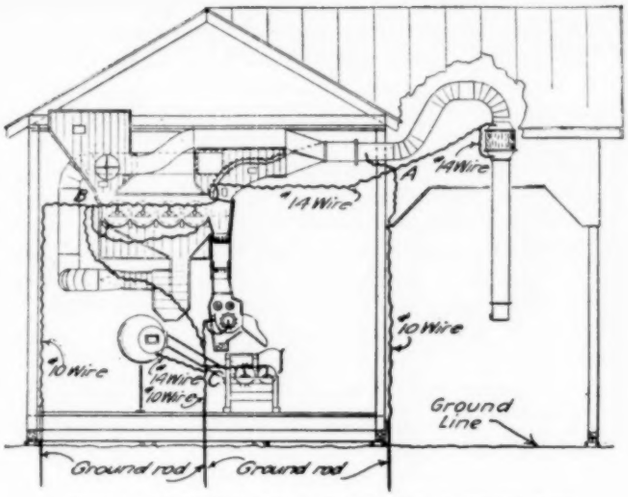

FIG. 4. METHOD OF GROUNDING COTTON GIN

the elimination of static electricity generated by the mechanical equipment in industrial plants is another important question which should be given attention. Satisfactory results have been obtained in the prevention of thresher explosions and fires in the Pacific Northwest and also in the prevention of cotton gin fires in the South assigned to this cause.

The development of aspirating systems for dust removal in grain elevators and similar industries, with specified limitations, and the preparation of a code covering the use of same should receive special consideration. In many industries this is already an essential requisite, especially if the product is commercially valuable.

Experimental work to develop effective methods for control of chokeups in elevator legs is essential. More disastrous dust explosions in grain elevators have been assigned to this particular cause than any other.

The designing of equipment for the prevention of flame propagation following the ignition of dust in grinding machines is commanding attention. The efficiency of revolving dampers, pressure vents and similar devices designed for relieving pressure should be determined.

Electrical sources of dust ignition are presenting themselves and must be given attention. While the electric lamp gives the most satisfactory artificial light, certain practices in use with the equipment have resulted in disastrous dust explosions.

The development and application of methods for measuring the quantities of dust suspended in air in grain-handling plants is one of the important phases demanding attention. Such determination is of importance not only to explosion prevention but to the health of the employees as well.

Chemical Research Problems

In addition to the experimental engineering work a number of chemical problems demand attention and consideration. The following more important ones are mentioned:

Determination of the flammability of various dusts, of the various methods and conditions under which dusts can be ignited, of the relation of moisture, ash, volatile content and other factors to the explosibility of dust.

Bureau of Chemistry,
Washington, D. C.

J. Ind. Eng. Chem., vol. 9, p. 9269, March, 1917.

Preparation of Small Pieces for Microscopic Examination

By Henry S. Rawdon*

During the preparation—i.e., the grinding and polishing—of the specimens for microscopic examination the edges are rounded and beveled off somewhat unless care is taken to protect them. In many cases such precaution is absolutely necessary—for example, case-hardened steels, coated metals, the fractured ends of test-bars, etc. Often specimens available are too small for use unless held in some kind of a matrix. For all such cases it is very convenient to coat the specimen with a heavy deposit of electrolytic copper, to mount it in a matrix of some kind and then to cut and polish a section through the resulting duplex specimen.

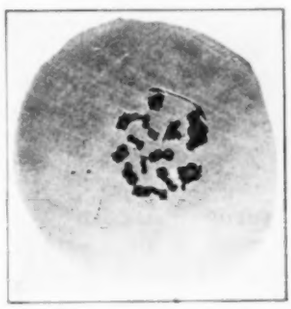

FIG. 1. VERY FINE COPPER WIRE MOUNTED FOR EXAMINATION. × 1

The common acid sulphate bath consisting of 250 g. crystallized copper sulphate and 50 g. (approximately 30 c.c.) concentrated sulphuric acid and water sufficient to make 1 liter of solution may be used for the solution in which the specimens are copper-plated. For iron, steel, zinc-coated articles and the like it is necessary to plate the specimen with a thin coating first in a nearly neutral bath before using the acid-sulphate bath, otherwise a spongy deposit will result if the specimen is inserted directly into the acid-sulphate bath. This preliminary coating may be very conveniently deposited by means of a cuprous cyanide bath.

Such a solution may be made as follows: The precipitate formed by mixing aqueous solutions of 300 g. each of copper sulphate and sodium carbonate (crystallized) is added to 5 liters of water. This is then reduced to the cuprous condition by adding 1 liter of water containing 200 g. sodium bisulphite. A more convenient way, however, is to bubble sulphur dioxide gas from a cylinder of the liquefied gas through the liquid and the suspended precipitate, until the color indicates that the reduction is complete. One liter of water in which 250 g. crystallized sodium carbonate has been dissolved is added; this is followed by a liter of water containing 250 g. potassium cyanide in solution and the whole, which upon shaking should give a clear solution, is diluted to a volume of 10 liters. In many cases, particularly with copper alloys, it is very desirable to deposit a preliminary layer of nickel before the heavy

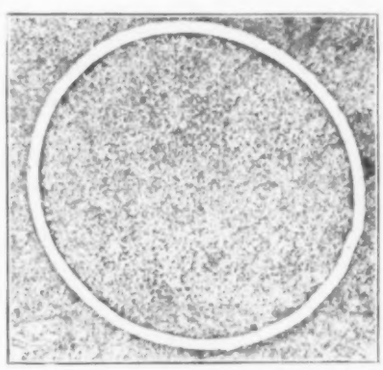

FIG. 2. ONE OF THE WIRES OF FIG. 1. × 100
Etched with ammoniacal solution of copper ammonium chloride.

*Physicist, Bureau of Standards.

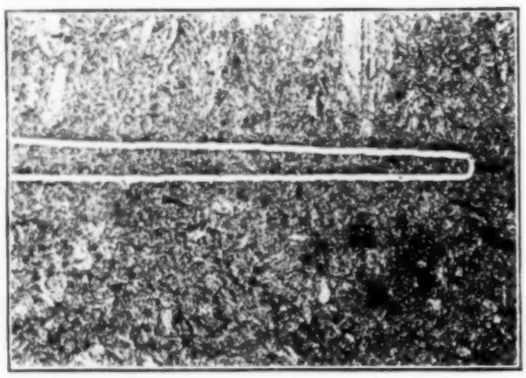

FIG. 3. SMALL STRIP OF COPPER. × 100
Etched with ammoniacal solution of copper ammonium chloride.

copper layer is added, so that there will be no uncertainty as to the line of demarcation between specimen and coating. This has been found very necessary in such problems as the microscopic study of corrosion of brasses and bronzes. A very convenient solution may be made up as follows: Nickel ammonium sulphate, 90 g.; ammonium chloride, 22.5 g.; boric acid, 15 g. and sufficient water to produce a volume of 1 liter.

After the specimens are heavily plated they are mounted as follows: A short section of brass or other tubing is filed smooth on one end and placed, with this smoothed end down, upon a block of graphite. The specimen is placed inside the tube with the face to be examined down, and then backed up with a matrix. Molten 50: 50 lead: tin solder is used a great deal where gentle heating of the specimen is not objectionable. In the case of hardened steels, etc., an alloy of very low melting point—for example Rose's alloy (lead approximately 28 per cent, tin 22 and bismuth 50, melting point

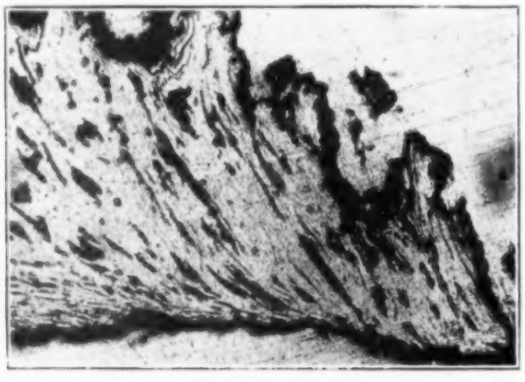

FIG. 4. SMALL LATHE TURNING OF MILD STEEL. × 100
Etched with picric acid in alcohol.

approximately 95 deg. C.) or Wood's alloy (lead 25 per cent, tin 13, bismuth 50 and cadmium 12, melting point 65 deg. C.)—may be used. A much cheaper substitute that is very suitable for almost all classes of work is made by mixing litharge (PbO) and glycerine in the form of a thick paste. This is poured around the specimen and will set and form a very hard surface which does not interfere with the polishing of the metal. It is sometimes necessary, however, to detach the specimen from such a matrix after polishing, before etching; this is particularly true if alkaline reagents, such as sodium picrate, are used. Often it is very convenient to cut a cavity in the graphite block so that the specimen, which is inserted into this hole, will project beyond the face of the solidified matrix which holds it. The projecting portion is then cut off with a fine hack saw and the metal is ground and polished without removing as much of the whole as would have been necessary if the specimen had been mounted flat within the ring.

The figures show some applications of the plating and mounting of metallographic specimens. Fig. 1 shows the polished face of a specimen prepared for microscopic examination. The material to be examined, copper wire 0.015 in. in diameter, was electrolytically plated with nickel and with copper, imbedded in a matrix of molten tin: lead alloy (solder) and a section of the duplex specimen, after cooling, was prepared.

A cross-section of one of the small wires of Fig. 1 is shown in Fig. 2. The white ring is the layer of nickel; outside of this a heavy layer of electrolytic copper was deposited.

A wire similar to that of Fig. 1 was rolled to a strip 0.003 in. in thickness before mounting in the manner described, then photographed in Fig. 3 at 100 diameters.

Fig. 4 shows a small lathe-turning of mild steel electroplated with copper and then mounted.

Diminished Production of Norwegian Paper Industry

The total number of cellulose mills in Norway is twenty-six. There are sixty-three wood-pulp grinding mills and forty-eight paper and cardboard factories. The total number of workmen employed in these mills is about 15,000. The annual production as of 1918 for these factories was as follows: 438,438 tons of cellulose and wood pulp, worth 132,600,000 crowns ($35,536,800); 116,889 tons of paper and cardboard, worth 86,200,000 crowns ($23,101,600), reports Consul-General Osborne, of Christiania. Most of the factories in these industries are located in the eastern part of Norway.

The situation at present for the Norwegian paper industry is not as bright. A large number of the mills have been obliged to resort to considerable reductions in output, and some of them have been forced to close, as has been the case with Torp Papirfabrik, with its 400 workmen. There are in the Norwegian paper factories from seventy-five to eighty paper machines, of which at present about one-half are idle. At some of the factories work is carried on only three days a week, and at others for five days a week. At the Borregaard factories, which have a capacity of 23,000 tons of paper a year—i. e., about one-fourth of the production of the entire country—a reduction of 50 per cent has been made. As yet no reduction in production has been made at the Borregaard cellulose mills, which have a capacity of 55,000 tons of cellulose annually.

One of the leading exporters stated recently that the supply of paper on hand in Norway was greater than the demand. There are practically no sales. In Copenhagen, where prices are lower, there are large stocks with no buyers. He further states that the prospects for the future are uncertain and that conditions will not improve until stocks in foreign countries have been consumed.

With regard to the wood-pulp situation, he states that as yet there has been no reduction in production in Norway, with the exception of cases where the production of wood pulp is being carried on in connection with the manufacture of paper. The stocks of cellulose and wood pulp on hand are not as large as those of paper.

Investigations of the Chemical Literature—II

Suggestions for Library Research in Public Documents and the General Periodical Literature in English, German and French—Periodicals Covering Special Fields—Check Lists and Union Lists of Periodicals*

By FRANK E. BARROWS

Public Documents

COPIES of some Government publications are sent free upon request to the particular bureau or department from which they are issued. When they are not thus available copies can be obtained from the Superintendent of Documents at the Government Printing Office, Washington. Price lists of Government publications relating to different subjects are issued by the Superintendent of Documents and are sent free upon request. The following is copied from one of these price lists:

> The Government of the United States is the greatest of all publishers of scientific works. It employs thousands of scientists, who are engaged the year round in making researches and investigations in all branches of agriculture, in geology, in mining, in electricity, in chemistry, in astronomy, in engineering, in aviation, in preventive medicine, in forestry, in irrigation, and almost all other branches of scientific inquiry. The arts of war as well as those of peace are also actively cultivated. The greatest art of all, that of free government, is strenuously carried on by President, Cabinet, Senators and Representatives.
>
> The results of all these activities of the most comprehensive and effective organization ever known are constantly reduced to print and poured out in an incessant flood from the largest printing works in the world.
>
> These publications of the Government Printing Office in Washington constitute the Public Documents of the United States.
>
> The greater number of them are sold by the Superintendent of Documents, located in the Government Printing Office. The Government did not establish this sales office for purposes of profit, but as a public convenience. The prices charged cover only paper and printing, no charge being made for the services of the statesmen and scientists who are the authors of the astonishingly varied books, pamphlets, periodicals and maps, and no commissions being allowed to anybody. The documents even have the freedom of the mails and are sent without postage.
>
> The only condition is that payment be made in advance of shipment. The Superintendent of Documents is not authorized to supply free copies, except of his price lists, and it is useless to ask him to do so.

Separate lists of publications of some of the Government departments or bureaus are also published—for example, the Geological Survey publications, those of the Bureau of Mines, those of the Library of Congress, etc., and lists of these are obtainable upon request.

Since 1914 the *Journal of Industrial and Engineering Chemistry* has had abstracts of Government publications.

Periodicals

The periodical literature is so extensive that a comprehensive search through it is often difficult, yet it forms one of the most valuable fields of search because of the numerous original papers which it contains and the wide field which it covers.

Frequently it is possible through the general reference works (previously referred to) to obtain reference to many of the relevant papers of the periodical literature. In organic chemistry the searcher may thus begin with Beilstein and Richter; in inorganic chemistry with Gmelin-Kraut or Abegg; and from these or other reference works he will be directed to the periodicals where the original papers are to be found. The extent to which the periodical literature can be covered in this way will vary greatly with different subjects.

Where suitable general reference works are not available, or when they have been exhausted, the searcher must turn to the periodicals themselves. The abstract journals are of special value for search purposes, because of the wide field which they include. *Chemical Abstracts* is thus an abstract index or digest of about 783 other periodicals covering the whole field of chemistry and chemical industry.

Cumulative or general indexes covering a number of years are also of particular value. A preliminary examination of a few of these general indexes will often enable the searcher to tell whether the literature of the subject he is investigating is abundant or meager, and in what direction the search can most profitably be continued.

In looking up original articles it will frequently be found that one article contains reference to many others of earlier date relating to the same general subject. These references may represent the results of a comprehensive search which the writer of the article made in preparation for his own investigations. Not infrequently one article will thus give a fairly complete review of the prior available sources of information along the very line in which the searcher is interested. Some of the prior articles thus referred to may in turn refer to others, and so on.

Again, bibliographies will sometimes be found either in the periodicals themselves or in some other publication of which the citation is given, and these bibliographies may give the results of an extended search made by the bibliographer in its preparation.

By making use of short cuts, such as bibliographies or articles giving the results of searches made by others, cumulative indexes of periodicals, abstract journals and general reference works, the searcher will frequently be able to obtain much of the readily available information upon any particular subject within a comparatively short time.

Abstract Journals in English

In making a comprehensive search, however, it is necessary to proceed in a systematic manner through the periodical literature itself. The abstract journals will naturally receive first consideration. The ten-year subject-matter index of *Chemical Abstracts* (1907-16) will furnish one of the best starting points for searching the recent literature. The annual indexes and the current numbers of *Chemical Abstracts* will

*For Part I see CHEM. & MET. ENG., vol. 24, No. 10, p. 423, March 9, 1921.

bring the matter practically up to date. It should be kept in mind, however, that *Chemical Abstracts* was less complete during the early years of publication, and that, complete as it now is, it cannot be relied upon as exhaustive or as including reference to everything of interest appearing in other chemical publications.

Next to *Chemical Abstracts*, the most valuable abstract journals in English are the *Journal* of the Society of Chemical Industry (published since 1882), and the *Abstracts* of the London Chemical Society.

The *Journal* of the Society of Chemical Industry has cumulative indexes for the periods 1882 to 1895, and 1896 to 1905, and annual indexes thereafter. It contains many original works, as well as a large number of abstracts, and it reflects and records the development of chemical industry in Great Britain, and, to a lesser extent, in other countries.

The *Abstract Journal* of the London Chemical Society is less comprehensive in the field it includes than *Chemical Abstracts*, but its abstracts are often more complete. It has been published as a separate publication since 1878. Prior to that date the abstracts appeared as a part of the *Journal* of the society. There are cumulative indexes covering the period from 1841 to 1872, and for each of the ten-year periods thereafter up to 1912.

Chemical News is another English periodical with a useful general index for the first 100 volumes, from 1860 to 1909.

Prior to *Chemical Abstracts* (1907), the abstract section of the *Journal* of the American Chemical Society was known as the *Review of American Chemical Research*. It first appeared in the *Technology Quarterly* for the year 1895, and continued as a part of that publication through 1901.

Beginning with vol. 3 (year 1897), the *Review of American Chemical Research* also appeared as a publication of the American Chemical Society, and continued to do so up to and including vol. 12, of the year 1906. From 1895 to 1901 it was contributed by members of the instructing staff of the Massachusetts Institute of Technology (Arthur A. Noyes, editor). In the first issue of 1895 (*Technology Quarterly*, vol. 8, p. 90) it was stated that:

> The purpose of this publication, which is hereafter to appear serially in this journal, is to present in a concise form a review as complete as possible of all original work having a chemical bearing published in the United States after the beginning of the year 1895.

While this publication is not comparable in its scope or value with *Chemical Abstracts*, yet it is of particular interest to American chemists as the predecessor of *Chemical Abstracts* and as a review of American research.

The *Journal* of the American Chemical Society is provided with a general index for the period from 1879 to 1898.

The *American Chemical Journal* also has cumulative indexes for the first ten volumes (1879 to 1888), for vols. 11 to 20 (1889 to 1898) and for vols. 21 to 50 (from 1899 to 1913). In 1914 it was incorporated with the *Journal* of the American Chemical Society.

Other Periodicals in English

Other important chemical periodicals in English are the following:

Journal of Industrial and Engineering Chemistry, published by the American Chemical Society since 1909.

Chemical & Metallurgical Engineering; (*Electrochemical Industry*, vols. 1 and 2, 1902-1904; *Electrochemical and Metallurgical Industry*, vols. 3 to 7, 1905-1909; *Metallurgical & Chemical Engineering*, vols. 8 to 18, 1910-1918; Chemical & Metallurgical Engineering, beginning with volume 19, 1918.)

Transactions of the American Electrochemical Society, published since 1902, and with a general index for the first twenty volumes (1902-1911).

Engineering and Mining Journal, published since 1866.

Journal of the Franklin Institute, published since 1826, and with indexes for vols. 1 to 120 (1826-1885), 121 to 140 (1886-1895) and 131 to 160 (1896-1905).

This list is not intended to be complete, and many others could be added, particularly those relating to special fields, such as metallurgy, oils, pharmaceutical chemistry, etc.

"Mineral Industry" and "Mineral Resources"

In the metallurgical and mineral field, "Mineral Industry" and "Mineral Resources" are deserving of special mention.

"Mineral Industry" has been published since 1892, when its first volume appeared as:

> A statistical supplement of the *Engineering and Mining Journal*, the mineral industry, its statistics, technology and trade, in the United States and other countries from the earliest times to the end of 1892.

It contains many articles on metallurgy, and a considerable number of bibliographies.

"Mineral Resources" is published annually by the Geological Survey, and has been published since 1882. In addition to its statistical information and many special articles on mineral production and technology, it also contains a considerable number of bibliographies.

German Chemical Periodicals

If the searcher is limited to the field of English literature, he may nevertheless make an extended search through the various cumulative indexes, abstract journals and other chemical periodicals, such as those above referred to and others relating to special fields. In any comprehensive investigation, however, the searcher will find it a serious handicap if he does not have a working knowledge of French and German, particularly German, since so much of the chemical periodical and technical literature is published in these languages, and especially in German, and since so many of the general reference works and works on special subjects are published in German.

Among the German periodicals *Chemisches Centralblatt* is the abstract journal corresponding to *Chemical Abstracts*. It goes back to 1856, and has general indexes covering at least part of the volumes since that time.

Another valuable German abstract journal is the *Jahresbericht über die Fortschritte der Chemie*. It has been published since 1847 and has cumulative indexes covering about ten-year periods up to 1904.

For industrial chemistry, Wagner's *Jahresbericht der Chemischen Technologie* is a valuable record of chemical technology in German and has cumulative indexes covering about ten-year periods from 1859 to 1904.

The *Berichte* der Deutschen Chemischen Gesellschaft, published since 1868, included abstracts up to 1896. It has general indexes up to 1907.

Other important German chemical periodicals are the

following, although the list is not intended to be complete:

Zeitschrift für Angewandte Chemie, with cumulative index covering the period from 1887 to 1907.

Zeitschrift für Anorganische Chemie, with a general index for the first fifty volumes from 1892 to 1906.

Zeitschrift für Physikalische Chemie, with cumulative indexes covering the first fifty volumes from 1887 to 1905.

Journal für Praktische Chemie, published since 1828, and with cumulative indexes.

Dingler's *Polytechnisches Journal*, published since 1820.

Liebig's *Annalen*, published since 1832 and with general indexes up to 1911.

Poggendorff's or Wiedmann's *Annalen*, published since 1824, with Gilbert's *Annalen* taking it back to 1799.

Die Chemische Industrie, published since 1877.

Monatshefte für Chemie, published since 1880.

French Chemical Literature

The French literature is less extensive than the German, but there are likewise abstract periodicals and periodicals with general indexes.

The *Bulletin* de la Société Chimique de France (prior to 1907 *Bulletin* de la Société Chimique de Paris) has been published since 1858 and contains abstracts. It also has general indexes up to 1906.

The *Annales de chimie et de physique* goes back to 1789 and for a long time contained abstracts. It has general indexes up to 1903.

The *Comptes rendus* has been published since 1835 and has general indexes up to 1900.

The *Revue générale de chimie pure et appliquée*, published since 1899, with its supplement, the *Répertoire général de chimie pure et appliquée*, published since 1901, is an abstract and review periodical.

The *Revue de chimie industrielle* has been published since 1890.

In the French literature (and the same is true of the literature of other countries) much of the chemical literature is contained in the general science publications—e.g., the *Moniteur Scientifique*, published since 1857.

Periodicals Covering Special Fields

In addition to the periodicals above mentioned, there are many more, including other periodicals of the same countries, as well as periodicals of other countries. In particular there are many periodicals relating to special fields, which those interested in those fields will naturally include in their investigation. We thus find periodicals devoted to rubber, oils, gas, colloids, metallurgy, electrochemistry, physical chemistry, medicinal chemistry, etc. A more detailed discussion of these various fields and periodicals is outside the scope of the present paper. The searcher will readily locate and identify the available periodicals of interest in connection with his investigation from the general reference works, from the abstract journals, or from the card index catalogs.

Not infrequently the searcher will be referred to periodicals which are not accessible in the library in which his search is being made, and it may be important to obtain further information about a particular article in such a periodical, or to find out whether the periodical itself is available in some other library.

If the date of publication and the author are known, a search of the contemporaneous periodical literature may disclose that the same article was reproduced, or that abstracts of it were published, in other periodicals. The same original article may thus be abstracted in *Chemical Abstracts*, in the *Abstracts* of the London Chemical Society, in the *Journal* of the Society of Chemical Industry, in *Chemisches Centralblatt*, and in other abstract or review periodicals, and it may also be reproduced in periodicals of other countries.

To ascertain whether any particular periodical is available in other libraries, reference must be had to the available check lists of these libraries.

Check Lists of Periodicals

For periodicals prior to 1895 the most valuable library check list of periodicals is that of Bolton in his "Catalogue of Scientific and Technical Periodicals, 1665-1895." This list includes 133 American libraries and about 3,160 scientific and technical periodicals, and indicates in which libraries each periodical may be found.

Various other check lists and union lists of periodicals have been issued for certain libraries, or the libraries of certain cities, including the following:

Union List of Periodicals, Transactions, etc., currently received in the Principal Libraries of the District of Columbia, pub. 1901, by the Library of Congress.

Catalogue of Technical Periodicals, Libraries in the City of New York and Vicinity, pub. 1915, by the United Engineering Society.

A List of Serials in the Public Libraries of Chicago and Evanston, pub. 1901, by the Chicago Library Club, and the John Crerar Library Supplement, pub. 1906.

A List of Current Periodicals in the Reading Room, the John Crerar Library, Chicago, pub. 1902.

A List of Serials in the Principal Libraries of Philadelphia and Its Vicinity, pub. 1908, and Supplement, pub. 1910. (Bulletins of the Free Library of Philadelphia, Nos. 8 and 9.)

A List of Periodicals, Newspapers, Transactions and Other Serial Publications Currently Received at the Principal Libraries of Boston and Vicinity, pub. 1897.

A List of Periodical Publications Currently Received by the Public Library of the City of Boston, pub. 1903.

Report of the Committee on "A List of the Scientific and Technical Serials in the Libraries of the State of Indiana." (Reprint from Ind. Acad. of Sci. Report for 1913.)

A Joint Catalogue of the Periodicals, Publications and Transactions of Societies and Other Books Published at Intervals, in the Various Libraries of the City of Toronto, pub. 1913, Univ. Press, Toronto.

Periodicals and Other Serials Currently Received by the Carnegie Library of Pittsburgh, 7th Ed., pub. 1915.

Current Periodicals on File in the Reading Room, Library of the Franklin Institute, Philadelphia, pub. 1916. (Bull. 4.)

Union List of Serials in the Libraries of Rochester, pub. 1917, Rochester Pub. Library.

Catalogue of the Periodicals and Other Serial Publications in the Library of the U. S. Dept. of Agriculture, Washington, pub. 1901 (Libry. Bull. 37); and Supplement 1, 1901-1905, pub. 1907.

Alphabetical List of Abbreviations of Titles of Medical Periodicals Employed in the Index-Catalogue of the Library of the Surgeon-General's Office, U. S. Army, from vol. 1 to vol. 16, inclusive, pub. 1895.

List of Serials in the Univ. of Illinois Library, and Other Libraries of Urbana and Champaign, pub. 1911. (Univ. of Ills. Bull., vol. 9, No. 2.)

List of Serials in the Univ. of Colorado Library, pub. 1913, Boulder, Col. (Univ. of Col. Bull., vol. 13, No. 1.)

Periodicals and Serials in the Library of the Catholic Univ. of America, Washington, pub. 1910.

List of Serials in the Univ. of California Library, pub. 1913. (Univ. of Cal. Libry. Bull. 18.)

List of Serials in the Leland Stanford, Jr., Univ. Library, pub. 1916.

(Part III will be published in a subsequent issue.)

Legal Notes

By Wellington Gustin

Employee May Recover Damages for Accident That Aggravates a Disease

An employee of the Coffeyville (Kan.) Vitrified Brick & Tile Co. had his foot lacerated while attempting to start a gas engine. Later he was found to be suffering from multiple sclerosis, which, according to the medical testimony, is a hardening of many areas of the brain and spinal cord which have become infected by some organism or poison that causes a deadening of the cells, from which they never recover, for the reason that they have no blood vessels to nourish them. When the nerve center hardens or becomes destroyed it fails to function—that is, to carry along the impulses from the brain.

About two years after the injury a trial was had and the court gave the employee compensation of $4,513.11. An appeal was made on the ground that the evidence did not establish the fact that the disease was caused by an injury arising out of and in the course of his employment.

There was a conflict in the testimony of physicians for both parties over the question whether multiple sclerosis could develop from a traumatic injury immediately after such injury. The authorities agree that there are various causes that produce the disease, and some include acute infection, or it may come from measles, scarlet fever, smallpox, whooping cough and other infectious diseases. Many include traumatic injuries, but the authorities indicate that in 50 per cent of the cases it was impossible to determine the cause. The physician of the injured employee gave his opinion that the condition of employee was due to an injury or shock which aggravated and may have been the absolute cause of the disease. The Supreme Court of Kansas affirmed the jury's verdict that the injury did precipitate or contribute to the development of the disease and was fully responsible therefor.

"The courts very generally hold that, if an existing disease is aggravated by accident or injury, compensation must be paid for the resulting injury. Note L. R. A. 1917 D., pages 105-129, 130.

"Even where a workman dies from a pre-existing disease, if the disease is aggravated or accelerated under circumstances which can be said to be accidental, his death results from injury by accident. 279 Ill. Rep., 356."

In a Connecticut case it was held that:

"Whatever predisposing physical condition may exist, if the employment is the immediate occasion of the injury, it arises out of the employment because it develops within it." 90 Conn., 539.

It has been held sufficient to justify an award under the workmen's compensation act in Maine, where "by weakening resistance or otherwise, an accident so influences the progress of an existing disease as to cause death or disability."

In a Massachusetts case, a workman "with an already impaired heart suffered further injury through the muscular exertion" required by her work, and it was held that she could recover compensation not only for that part of the injury resulting directly from the work, but for that following directly from the previous defective condition of her heart.

The Kansas court said: "It is true that under our compensation law a workman may not recover compensation for an incapacity resulting merely from a disease, although the disease developed in and was caused by the nature and condition of his employment. It is only where he has sustained some accidental injury, arising out of and in the course of his employment, which aggravates a disease and thereby causes incapacity, that he may recover compensation."

Liability of Buyer by Acceptance of Part of Shipment

The liability of a buyer by an acceptance of part of the goods shipped him was a question presented the Court of Appeals of Kentucky in the case of B. R. C. Battle Co. vs. Peaslee-Gaulbert Co. The latter, a wholesale company, of Louisville, Ky., ordered a bill of glass bottles of the former, a manufacturer of Louisiana. While seven different kinds of bottles were ordered, but four kinds were shipped, and not in the quantities ordered except in one instance. Two kinds of the bottles were defective and the buyer declined to pay for them. The seller ordered a return of the whole shipment within a few days after receiving the complaint of the buyer.

Subsequently the seller filed suit to cover for the entire shipment, amounting to $1,609.76. The buyer admitted liability in the sum of $723.20 for the good bottles, and resisted payment for the defective bottles by counterclaim for damages of an alleged warranty. Upon trial of the case the seller recovered a judgment against the buyer for $259.52.

The trial court held that the contract was severable, and permitted the buyer to recover, upon its counterclaim, damages for breach of an implied warranty as to the two rejected kinds of bottles, of which action alone complaint is made upon the appeal. The seller contended that the contract was entire, and not severable, and that by the acceptance of a part of the shipment the buyer became liable for the whole shipment.

On appeal the Court of Appeals said the several different kinds of bottles involved were separately priced and separately invoiced, and constituted different items not inherently interdependent, but easily severable, of a single order in which the aggregate sum does not seem to have been considered or mentioned. Such contracts, says the court, may be either severable or entire, depending upon their terms and the intention of the parties involved, to be ascertained from the language employed, the character of merchandise, attendant circumstances, and the act of the parties. (2 A. L. R., 643.) Further it appears, as the court found, that the seller did not itself regard the contract as entire, because without agreement so to do, it accepted and complied with only several parts thereof. And there was nothing in the contract nor in the acts of the parties to indicate that either considered it other than a severable contract, except the telegram and letters of the seller to the buyer after it had been informed by the buyer that the latter treated and considered the contract as severable, by accepting in part and rejecting in part the goods shipped. In like manner the court pointed out that the seller had treated it as severable, by accepting in part and rejecting in part the order tendered it by the buyer.

Influence of Silicon Upon the Properties of Ferrosilicon

Pure Commercial Alloys Containing More Than 50 per Cent Silicon Contain the Primary Compound FeSi and a Decomposition Product $FeSi_2$—Very Accurate Estimates of Silicon Content Can Be Made Quickly by Specific Gravity Determinations

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FERROSILICON has repeatedly been studied by different investigators. These investigations have been based chiefly upon ferrosilicon produced in small charges, the alloys being then treated with different solvents and the residues analyzed. Hahn assigned[1] the compounds Fe_2Si, FeSi and $FeSi_2$. De Chalmot[2] described the compound Fe_3Si_2. His determinations, however, checked up so poorly that they were not accepted as full proof of the existence of this compound, and none of the later investigators have encountered it. Gins[3] believed that the compound Fe_2Si was produced in the blast furnace from 10 per cent ferrosilicon. Tick maintained that this compound did not exist in the pure state, but only in combination with manganese such as the compound $(FeMn)_2Si$. Naske[4] believed that he had found the compound $FeSi_3$ in 50 per cent ferrosilicon after treatment of this alloy with hydrofluoric acid. This compound was not encountered by any later investigators and there is little proof of its existence.

In 1905, W. Guertler and G. Tammann[5] published the results of their researches on ferrosilicon, based chiefly upon thermal investigations. They melted Fe (99.77 per cent) and Si (98 per cent Si, 1 per cent Fe) in a porcelain test-tube placed in an electric furnace and observed the cooling and heating curves. Thermo-elements were protected by ordinary porcelain tubes in the investigation of alloys containing less than 75 per cent Si. With higher silicon content the porcelain tubes were protected by sheet platinum and magnesia. Melting was performed in an atmosphere of nitrogen. In their investigations, results of which are diagrammed in Fig. 1, they encountered the two compounds Fe_2Si and FeSi, but not the compounds Fe_3Si, Fe_3Si_2, $FeSi_2$ and $FeSi_3$. However, we are not justified in excluding the existence of these last-named compounds on this account. Guertler and Tammann worked with very small charges at an average rate of heating and cooling of 100 deg. per minute. It is easily understood that the manner of crystallization obtained in this way is different from the manner obtained in large commercial charges; for instance, Dr. Pick (1906) found crystals of $FeSi_2$ in large blocks of ferrosilicon which had cooled slowly. On the whole, the following list represents the supposed ferrosilicon compounds, all but the first being relatively definitely proved:

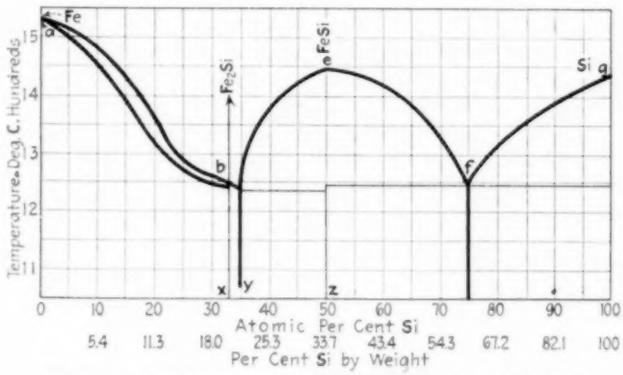


FIG. 1. EQUILIBRIUM DIAGRAM FOR IRON: SILICON ACCORDING TO GUERTLER AND TAMMANN (1905)

	Per Cent Si		Per Cent Si
Fe_3Si	14.289	FeSi	33.33
Fe_2Si	20.00	$FeSi_2$	50.00
Fe_3Si_2	25.00	$FeSi_3$	60.00

Materials for the Present Investigation

For investigation a series of samples of ferrosilicon containing from 49.1 per cent Si to 77.46 per cent Si were obtained from Borregaard, and a sample containing 93.41 per cent Si from Kopperaaen, Meraker.

The following samples were selected and analyzed:

No.	Per Cent Si	No.	Per Cent Si
1	93.41	12	66.25
2	77.50	13	65.70
3	76.28	14	64.10
4	76.00	15	61.95
5	75.90	16	61.40
6	74.82	17	59.10
7	72.90	18	56.01
8	72.55	19	52.30
9	72.00	20	50.90
10	71.25	21	49.10
11	70.32		

It was necessary to polish the specimens with the greatest care, because there was a tendency for large pieces to break loose from the surface, especially with alloys between 55 and 70 per cent Si. Alloy No. 18 with 56.01 per cent Si was so brittle that it could easily be broken apart with the fingers. The most brittle specimens were bonded with Canada balsam in a bunsen flame whereby they received sufficient mechanical strength for polishing.

Eutectic and separated crystalline aggregates could easily be distinguished under the microscope without etching. An attempt was made to etch the sections with weak hydrofluoric acid and weak NaOH solutions in order to see the structure of the crystalline aggregates. However, this etching gave unfavorable results, the portion of the sections which were broken out became larger and the image in the microscope less distinct. Crystals of $FeSi_2$ etched satisfactorily.

Tidskrift for Kemi, vol. 16, No. 1 (1919). From the Technical High School Laboratories of Technical Inorganic Chemistry, Prof. Thv. Lindeman.

[1] *Lieb. Ann.* vol. 129, p. 57 (1864).
[2] *J. Am. Soc.*, vol. 21, p. 58 (1899).
[3] *Elektrochemie* (1901), vol. 3, p. 38.
[4] *Chem. Zeit.* (1903), vol. 27, p. 48.
[5] *Z. Anorg. Chem.*, 1905, vol. 47, p. 163.

FIGS. 2 TO 5. MICROSTRUCTURE OF FERROSILICON SAMPLES
Fig. 2. 93.4 per cent Si. × 50. Fig. 3. 77.5 per cent Si. × 50. Fig. 4. 56 per cent Si. × 65. Fig. 5. 49.1 per cent Si. × 20

In silicon-rich melts, according to the diagram (Fig. 1), one would expect to find silicon crystals in a surrounding eutectic having a composition of about 60 per cent Si and 40 per cent Fe. This proved to be the case, except that the eutectic apparently has a composition of about 55 per cent Si and 45 per cent Fe. Crystals of silicon were observed as rather long crystalline aggregates in the midst of the surrounding eutectic; they are gray and have a bright hard surface with only a few small pieces chipped away from the surface. The surrounding eutectic presents a dotted structure with a light gold color. Large portions of the eutectic which were removed during polishing appear as black spots under the microscope.

Silicon in alloy No. 1 (93.41 per cent Si) appears in large smooth surfaces, separated by veins of eutectic (Fig. 2). The relative proportion of Si and eutectic could not be determined with accuracy by the planimetric method on account of the relatively large sizes of the crystals.

In Fig. 3 I have found it possible to obtain more truly representative portions of silicon and eutectic in one microsection. An alloy containing 56.01 per cent Si shown in Fig. 4 is the lowest in the series where crystals of pure silicon are found. This is not a representative picture of the distribution of Si, but it is that part of the section which shows the maximum amount of crystallized silicon; other portions were entirely without crystallized silicon. Intermediate analyses (alloys 2 to 17) show a progressively diminishing silicon content and an increasing eutectic content. As above noted, the eutectic works out to be about 55 per cent Si, 45 per cent Fe.

Besides the sections which are illustrated above, alloys 13, 14, 15 and 16, with 65.70, 64.10, 61.95 and 61.40 per cent Si respectively, were also investigated with the microscope. These samples, together with No. 17, approach the percentage corresponding closely to the compound $FeSi_2$ proposed by Naske. I could, however, find no indication of such a compound. All specimens showed a uniform decrease in Si and increase in eutectic content. In alloy 6, containing 74,82 per cent Si, I estimated that the amounts of crystallized silicon and eutectic present were almost equal. Figuring eutectic to contain 55 per cent Si, we obtain:

	Per Cent Si
50 per cent Si	50
50 per cent eutectic	27.5
Total	77.5

a departure of about 3 per cent from the correct amount as given by chemical analysis.

Alloy 19, containing 52.3 per cent Si, shows the same eutectic mixed with a new crystal form, FeSi. (See Fig. 1). Measurement of various photographs of this alloy show that the crystallized FeSi comprises from 10 to 15 per cent of the whole surface. In the former case:

	Per Cent Si
90 per cent eutectic	49.5
10 per cent FeSi	3.33
Total	52.83

In the other extreme, 15 per cent FeSi:

	Per Cent Si
85 per cent eutectic	46.75
15 per cent FeSi	5.00
Total	51.75

Whether one decides 10 or 15 per cent FeSi makes only about 1 per cent difference in the resultant total silicon (compare with 52.3 by chemical analysis). FeSi has a strong metallic luster and a white color. Fig. 5 is a photomicrograph of alloy 21. This alloy is estimated to contain about 34 per cent FeSi.

	Per Cent Si
66 per cent eutectic	36.3
34 per cent FeSi	11.3
Total	47.6

an error of about 1.5 per cent.

In ferrosilicon with silicon content ranging from 48 to 60 per cent a large number of small geodes are found. Fig. 6 shows the largest one found. In occasional pieces a whole series of small geodes were found varying from 0.5 to 1.0 mm. in diameter.

In order to investigate the contents, individual crystals were picked out carefully, avoiding as far as possible taking portions which lay directly upon the solid ferrosilicon alloy, in order not to risk contamination. The fragments gave the following analysis:

	Per Cent Fe	Per Cent Si
1	51.0	50.8
2	49.3	49.1

This corresponds closely to the compound $FeSi_2$.

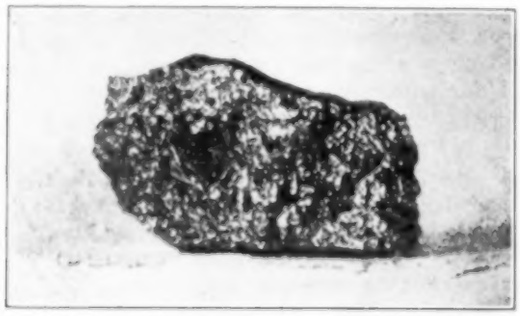


FIG. 6. LARGEST GEODE FOUND. × 2.

The first matter which had to be determined was whether geode contents consisted of an actual compound, or if it were only an ordinary alloy which had assumed this form. A small blade from a geode, after etching with hydrofluoric acid, and magnified 100 times, showed individual crystals lying closely together, a homogeneous crystalline formation with no

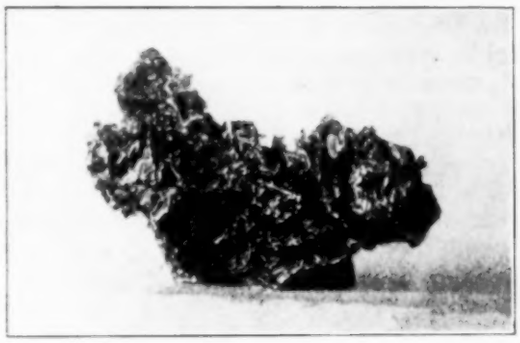


FIG. 7. LARGE GEODE IN 75 PER CENT FERROSILICON. NATURAL SIZE

foreign ingredients present. It is, therefore, well established that these geode contents consist of one kind of crystal, which according to the above analyses must be the compound $FeSi_2$.

Fig. 7 shows a crystalline geode found in ferrosilicon about 75 per cent Si. Its analysis gave:

	Per Cent Si	Per Cent Fe
1	82.04	17.48
2	80.95	18.80

If the geodes consisted of homogeneous crystals it would correspond approximately to the compound $FeSi_2$.

Microscopic examination showed at once a compound structure. After observing the section in the microscope it is seen that the geode consists of two distinct constituents—six cornered crystals, lying one on top of the other with an intermingling eutectic; the same eutectic, light gold in color, which was noticed in previous work (55 per cent Si). The maximum eutectic comprised 10 per cent of the whole. For example, suppose 10 per cent eutectic present. Then, if the crystals were to consist of pure silicon we could obtain:

	Per Cent Si
10 per cent of eutectic contains	5.5
90 per cent assured pure	90.0
Total	95.5

Since the analysis gave only an average of 81.5 per cent Si, this hypothesis is excluded.

Assuming that in the average analysis (81.5 per cent Si and 18.5 per cent Fe) all the iron exists as a portion of the eutectic, the distribution of silicon is:

	Per Cent Fe	Per Cent Si
41.1 per cent eutectic contains	18.5	22.6
The chemical analysis is	18.5	81.5
Balance of pure silicon		58.9

The probability is, therefore, that the geode is more nearly constituted as follows:

	Per Cent
Free silicon	58.9
Unresolved eutectic	31.1
Eutectic surrounding the crystals	10.0
Total	100.0

Particles about 5 mm. diameter of alloys 1, 4 and 11 were treated with cold 20 per cent NaOH solution. After a lapse of one day the particles crumbled into small bits, and after a lapse of one week no more dissolved.

The weakly magnetic undissolved residue was filtered off, washed, dried, and analyzed, giving:

Sample	1		4		11	
	Per Cent Si	Per Cent Fe	Per Cent Si	Per Cent Fe	Per Cent Si	Per Cent Fe
1	54.66	45.45	54.90	45.66	55.30	44.80
2	54.45	45.30	55.20	44.97	55.25	44.80

This gives an average of 54.96 per cent Si, 45.13 per cent Fe. The caustic has, therefore, dissolved out the crystallized silicon from the alloy and left remaining an alloy which shows the same constant composition for all three samples. This is the eutectic which is not attacked by the cold caustic. According to this, the composition of the eutectic should be 55 Si, 45 Fe.

In the diagram (Fig. 1) the position of this eutectic is shown at about 60 per cent Si (atomic percentage = 75). The few investigations which they carried out upon this eutectic and the large sources of error which are attached to their work indicate that the position of the eutectic at 60 per cent Si must be wrong. The eutectic must surely not be far from 55 per cent Si and 45 per cent Fe. The curves, therefore, obtain a slightly altered appearance as shown in Fig. 8.

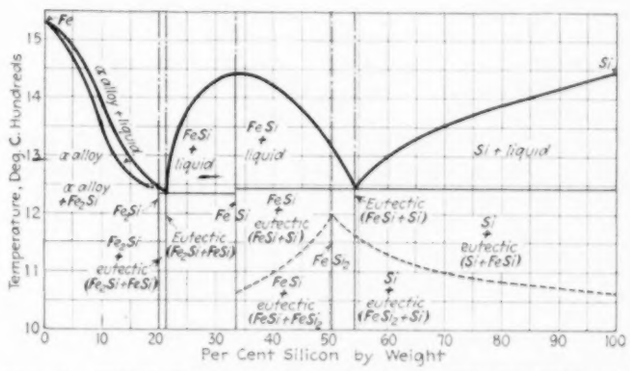


FIG. 8. EQUILIBRIUM DIAGRAM FOR IRON: SILICON ACCORDING TO LOWZOW AND HOUGEN (1919).*

The line *ef* becomes steeper in slope than the line *fg;* also for two alloys lying equidistant from the eutectic and on opposite sides when computed in atomic percentages show a great difference in the relative proportions of eutetic with their respective Si and FeSi.

The undissolved residues from alloys 4 and 11 after one week of treatment with cold caustic were treated with warm 20 per cent NaOH for one week. The warm caustic attacks the small eutectic grains, which then fall into a powder. The powder, washed and dried, possesses greater magnetic properties than the previously discovered eutectic. The analysis gave:

	Per Cent Si	Per Cent Fe
No. 4	33.8	66.3
No. 11	33.9	65.9

This corresponds to FeSi—33.4 Si and 66.6 Fe.

The warm caustic dissolved the silicon from the eutectic and left the FeSi undissolved.

*TRANSLATOR'S NOTE: The work of T. Lowzow has established the exact composition of the eutectic FeSi and Si and has explained the formation of the compound $FeSi_2$ from this eutectic upon slow cooling. From interpretation of the modified equilibrium diagram the translator has drawn up this constitutional diagram. The dotted line below the solidus line merely indicates the probable manner of formation of the compound $FeSi_2$ and is not intended to even approximate the exact equilibrium conditions.

The specific weights of ferrosilicons given in Hönigschmid's works of 1914, "Carbides and Silicides," are:

Fe_2Si (20% Si)	7.0 (after Moissan) 22°C.
	6.75 (after Lebeau) 22°C.
$FeSi_2$ (25% Si)	6.36 (after De Chalmot)
FeSi (33.33% Si)	6.17
FeSi (50.00% Si)	5.40 (after Lebeau)

De Chalmot gives for technical ferrosilicon the following specific gravities:

	12 per Cent Si	25 per Cent Si	46 per Cent Si
Specific gravity	6.8	6.36	4.85

To determine specific gravity carbon tetrachloride is used; this does not attack any of the constituents of ferrosilicon. One disadvantage of carbon tetrachloride is its large temperature coefficient of expansion and high vapor tension. The specific gravity of carbon tetrachloride was determined in a Spengels pycnometer at 14.9, 17.1 and 20.1 deg. C. respectively, with parallel investigations of distilled water. Results:

Sp.gr. at 14.9 deg. C	1.6034
Sp.gr. at 17.7 deg. C	1.5982
Sp.gr. at 20.1 deg. C	1.5936

Ferrosilicon is permeated through its whole mass with gas and air spaces. The specific weight must, therefore, be determined in powder form. To determine this a bottle pycnometer was used. It was found absolutely necessary to work in a thermostat. A couple of investigations were made without the thermostat, with reading of the variable temperatures and corrections to the corresponding specific gravity of carbon tetrachloride; this gave very bad results because of cumulative errors. Temperature of the room was held at about 18 deg., maximum 19 deg., and the thermostat was kept constant at 20 deg. C. After filling the pycnometer with CCl_4 and fitting on the cork it was placed in the thermostat. When the pycnometer had been heated to 20 deg. the contents expanded and the overflow was driven out of the pycnometer through the capillary stem. At the moment when no more CCl_4 came out a cap was placed over the capillary and the pycnometer was dried and weighed. During the first investigations a small glass cap was used, but this did not prevent the CCl_4 from evaporating. By fitting on a small piece of rubber tubing, which was closed at one end by a small glass bulb, all evaporation of CCl_4 was prevented.

After this the weighed amount of ferrosilicon was placed into the pycnometer, filled one-third full with CCl_4 and shaken well in order to drive out most of the entrapped air. The remaining air was expelled by evacuation. The pycnometer was then filled with CCl_4, stoppered and set into the thermostat. The operation was continued as described above. Results are given in Table I.

TABLE I. SPECIFIC GRAVITY OF POWDERED FERROSILICON

No.	Per Cent Si	Sp.Gr.	No.	Per Cent Si	Sp.Gr.
1	93.41	2.542	12	66.25	3.453
2	77.50	2.944	13	65.70	3.560
3	76.28	3.010	14	64.10	3.602
4	76.00	3.050	15	61.95	3.780
5	75.90	3.051	16	61.40	3.857
6	74.82	3.060	17	59.70	4.102
7	72.90	3.162	18	56.01	4.260
8	72.55	3.205	19	52.30	4.200
9	72.00	3.220	20	50.90	4.342
10	71.25	3.222	21	49.10	4.630
11	70.32	3.260			

These specific gravities are shown graphically in Fig. 9. The points marked 1′, 2′ and 3′ indicate the specific gravities of FeSi, $FeSi_2$ and Si respectively. Specific gravities are seen to lie fairly regular between 70 and 78 per cent Si. This is to be expected, because these alloys are produced from iron scrap and quartz and contain a very small amount of foreign constituents. No. 4 lies farthest from the curve; its analysis shows 76 per cent Si, but this determination figured from the specific weight curve should be nearer 75.2 per cent Si.

In the production of high ferrosilicon of about 75 per cent Si, very close estimations of the silicon analysis can be made in less than one hour by this specific gravity method, whereas an ordinary chemical analysis takes almost two days. This has a great commercial significance. By one step an approximate analysis can be rapidly made. If compelled to wait two days for an exact analysis there would be a risk of having the operation of the smelting furnace go wrong before being aware of it.

Poorer conditions exist with lower percentages of Si. The dotted portion of the curve represents the mean of the specific gravities. A variation from this line is to be expected since my ferrosilicon alloys were made from iron ore and quartz, naturally giving a larger opportunity for the introduction of impurities.

In order to determine if the constituent minerals would have this effect upon the specific gravities, thin sections were made upon the following samples:

Number	1	2	11	16	18	20
Per cent Si	93.41	77.50	70.32	61.40	56.01	49.10

These were inspected in the microscope, using transmitted polarized light. In 1, 2 and 11 no minerals were found. On the other hand 16, 18 and 21 contained fairly small mineral grains in various amounts. One would expect that these were unreduced quartz; however, quartz could not be detected. Ca-Mg silicates were found, which accordingly reduce the specific gravity.

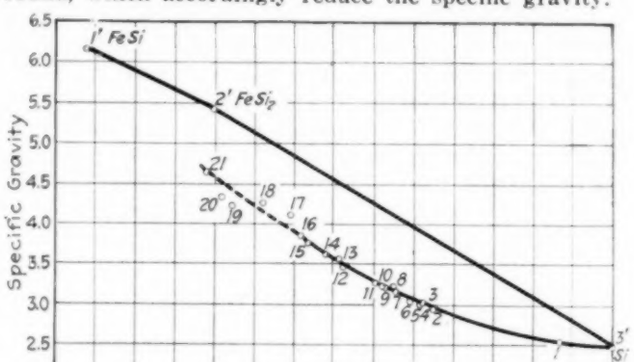


FIG. 9. SPECIFIC GRAVITIES OF POWDERED FERROSILICON

Continuing further with decreasing silicon percentages toward the eutectic (55 per cent Si), the alloy becomes continually duller in appearance. It also becomes more and more friable. No. 18 (56.01 per cent Si) is so friable that it can easily be crumbled with the fingers. Below 55 per cent Si, the alloy changes rapidly in character. Large laminated crystals of FeSi are present and impart to the alloy 50.90 per cent Si a strong metallic luster, a silver white color and great mechanical strength. Alloys which lie a few per cent to the left and up to 10 per cent to the right of the eutectic (55 per cent Si), say between 53 and 65 per cent Si, have, however, fairly little mechanical strength

United States Export Trade in Corn Sirup and Corn Sugar

With corn the greatest crop in the United States and a 1920 record yield of 3,199,126,000 bu. of the average farm value of 87.3c. per bu., according to the Bureau of Crop Estimates, it is of current interest to note the magnitude of the export movement in two of its many byproducts—glucose (corn sirup) and grape sugar (corn sugar).

All records were broken in the calendar year 1919 by an aggregate exportation of 255,617,709 lb. of corn sirup and corn sugar, valued at $15,139,944, or an increase of 346 per cent in quantity and of 338 per cent in value over the 1918 shipments of 57,332,150 lb., invoiced at $3,458,927. Little variation is shown in the average annual export price of about 6c. per lb. from 1918 to 1919. The United Kingdom ranked first as a market for these products, taking 39,345,968 lb., worth $2,368,015, in 1918, and 159,033,298 lb., at $9,563,339, in 1919.

From 1918 to 1919, shipments to France increased from 3,984,452 to 52,042,071 lb.; to Argentina, from 1,793,900 to 6,341,204 lb.; and to Italy from 845,537 to 5,909,980 lb. Considerable gains are also recorded in the 1919 trade with Belgium, Greece, Canada, New Zealand, the Philippines, British South Africa and other countries.

Industries Utilizing Corn Sirup and Sugar

Corn sirup is a distinctively American product. Though less sweet than cane sugar, it can be used in many ways as a satisfactory substitute therefor. Glucose was discovered about 1800. In this country it is largely used in confectionery and in leather manufacture, in the form of an almost transparent, sirup liquid composed of dextroglucose, maltose, dextrine and water prepared from cornstarch by heating with dilute acids. It was formerly used to a large extent in brewing. For converting starch into glucose (hydrolysis), sulphuric acid is generally used. Various forms in commercial demand are "mixing glucose," used by sirup and molasses manipulators; "jelly glucose," for making jellies from evaporated apple juice or other materials; "confectioners' glucose;" "brewers' glucose," used as a substitute for malt in brewing; and "anhydrous grape sugar."

Well-made glucoses are perfectly wholesome and have a definite food value. It is said that the chief objection to their use in food preparations is due to the fact that the consumer is often misled in regard to the value of the products containing them, as glucoses are often used in the manufacture of inferior or adulterated goods. The manufacture in the United States of corn sirups for table use is highly developed, and there is an increasing domestic demand for various popular brands of uniform good quality. This demand may be partly due to the proportionately greater increase in the price of cane and maple sugar and sirups since 1917. Normally, in pre-war times, the value of cane and maple products greatly exceeded those of corn sugar and sirup, but the relative increase in price of the corn products has been very much less. Cane sugar has sold in this country as high as six times its pre-war value, while the price of glucose is only about three times greater. This is apparent in the exports of glucose amounting to 124,140,171 lb., valued at $2,657,034, in the calendar year 1910, as compared with practically the same quantity, 124,202,985 lb., exported in the first nine months of 1920, invoiced at $7,806,101.

Years	Glucose Pounds	Glucose Value	Grape sugar Pounds	Grape sugar Value
1910	124,140,171	$2,657,034	46,791,855	$937,391
1911	146,643,655	2,953,120	45,249,422	878,841
1912	134,842,547	3,256,550	40,328,283	966,383
1913	165,554,073	3,760,203	40,641,718	906,881
1914	127,201,099	2,895,189	35,681,124	775,036
1915	151,487,376	4,107,547	36,842,686	945,238
1916	136,379,198	3,295,823	38,684,528	993,478
1917	152,076,927	7,158,670	25,765,875	961,908
1918	42,740,417	2,552,637	14,591,733	906,290
1919	220,380,761	13,169,051	35,236,948	1,970,893
1920	124,202,985	7,806,101	9,918,320	618,897

* Nine months ended with September.

Variations in Export Trade During Last Decade

It will be noted from the accompanying table that while the export trade in glucose (corn sirup) has been greatly extended during the last decade, 1910 to 1920, that in grape sugar (corn sugar) declined in quantity from 46,791,855 lb. in 1910 to 35,236,948 lb. in 1919, but increased in value from $937,391 to $1,970,893 in the same time. A still further decline in the exports of grape sugar occurred during the first nine months of 1920—9,918,320 lb., valued at $618,897, as compared with 24,590,745 lb. invoiced at $1,321,119 in the corresponding period of 1919.

The combined exports of glucose and grape sugar for the nine months ended September, 1920, are 134,121,305 lb., valued at $8,424,998, or an average export price for this period of 6.3c. per lb. Corresponding exports in 1919 were 194,681,907 lb., invoiced at $11,082,078, or 5.7c. per lb.

Tin Plate Industry and Trade in Swansea

The tin plate industry of Great Britain is confined exclusively to South Wales, with the exception of a single plant in North Wales. Of the 82 works in the Welsh tin plate industry, 65 are located within a radius of 18 miles from Swansea. That city may rightly claim, therefore, to be the center of the industry.

The following table from the report of the Royal Metal Exchange of Swansea shows the volume of the trade of the United Kingdom in tin plate, black plate and galvanized sheets for the years 1913, 1918 and 1919, and is applicable to the district of Swansea, since virtually all the tin plate and black plate, as well as the larger part of the galvanized sheets, are produced there.

	1913 Tons	1918 Tons	1919 Tons
Exports of tin plate	494,497	223,509	289,761
Exports of black plate	71,775	4,571	32,511
Estimated home consumption of tin and black plates	255,798	226,355	229,711
Estimated output of tin black plates	822,070	454,485	551,983
Exports of galvanized sheets	762,075	8,835	186,101

Though the Welsh tin plate industry has a very important home market, the permanent success and further expansion of the industry must depend upon its export trade. Of the home trade which it had in tin plate and black plate in 1913, it recovered 229,711 tons in 1919. Of the export trade in these articles in 1913, it has recovered in tin plate 289,761 tons out of 494,497 tons; and in black plate, 32,511 tons out of 71,775 tons. That is, it has recovered 58 per cent of its pre-war tin plate export trade and 45 per cent of its pre-war black plate export trade.

Whether it will be able to recover a further appreciable per cent of its lost trade is somewhat questionable.

Porcelain Enameling Furnaces

By C. G. Armstrong*

THE art of ceramics had its beginning when primitive man took such clay as he found at hand and molded it into such shapes as fancy or needs dictated. Sun drying and accidental firing disclosed the secrets of pottery to him and the art of pottery, the forefather of enameling, had its beginning. To claim that the ceramic art was originated by any one race has been proved to be fallacious in view of the incontestable evidence that pottery was made by the Indians of Mexico and the prehistoric people of Egypt and China long before they were aware that any people lived in the world other than themselves.

Archæologists have found ruins along the Nile over 10,000 years old in which pottery played a part, but it is not until 1300 B.C. that we find any trace of glazes or enamels being applied to the pottery. The discovery of glass by the Assyrians, prior to 1300 B.C., is considered to be the beginning of the art of enameling, and the temple of Rameses III contained wonderful examples of enameling which have not been surpassed in magnific nce to this day. Thus it is safe to state that enameling had its birth in Egypt.

From Egypt the art of enameling spread to Rome and was carried by the Romans to England, France and Germany at the time of their invasions of those territories.

During the early part of the eighteenth century the art of making miniature enamel pieces on gold, silver and copper assumed fair proportions, and yet we do not find any record of attempts to enamel iron or steel prior to 1840, when a method for the enameling of cast iron by the dry process was discovered. The enamel was applied only on the inside of the receptacle at first, as muffle firing was very imperfect. The muffles of that period were made of cast iron with steel base plates and were far from being satisfactory, though some very excellent pieces of work were turned out.

In 1860 the enameling of sheet iron was begun, and upon the advent of the drawing press and clay muffle in 1870 the process of porcelain enameling steel as we know it today developed into the enameling industry.

Formulas

The formulas used in 1850 and those of today, while fundamentally the same, have had to undergo many changes in order to produce an enamel which would have the proper physical and chemical properties to work on the modern basic sheet steels.

In this paper we shall carefully avoid the discussion of formulas, for with the forty or more variable ingredients going into a formula, eight of which on an average are used, there are possibly 76,920,000 formulas. Time is too short even to begin such discussion; furthermore, we have to deal with enameling furnaces—furnaces in which all correct formulas should work properly.

With the development of the industry in Europe and the establishment of an American enameling plant at Woodhaven, N. Y., in 1863, we arrive near home and are prepared to discuss the furnaces.

In the strictly ceramic lines of the porcelain enamel industry having to do with the preparation and applications of the enamel, progress until recently has been fairly slow and has lagged considerably behind the development of the machinery used in forming the steel shapes for enameling. The designs of furnaces for the firing of the enamel have also been changing very slowly since the inception of the clay muffle in 1870 and until recently there has been no marked improvement. To review the development in porcelain enameling furnaces from the time when they were only a flat hot stone through the different stages of the intermittent beehive oven, cast-iron muffles, clay muffles to the modern muffles would consume too much space. Suffice it to say that since the introduction of the clay muffle no radical changes have been made, except in the placement of the flues and method of firing, until the introduction of the carborundum muffle.

Types of Furnaces

Present-day furnaces may be divided into two classes as to muffle types—the semi-muffle and full muffle—and also several classes as to method of firing, or briefly, coal-fired, producer-fired, semi-producer, recuperative, oil-fired and gas-fired. The electric furnace has not entered the commercial field as yet, due to great heat losses entailed.

Various types of furnaces are used, most of the variations being in the flue system. Very elaborate flue layouts have been constructed in some furnaces with the idea of extracting as much of the available heat as possible from the gases before they leave the furnace. This, of course, is not necessarily always successful, for those flues placed in the roof and upper walls which receive their heat by radiation often are a means of extracting heat from the furnaces and causing the flue gases to leave the furnace at a much higher temperature than they would if taken out by means of shorter flues. The logical thing to do, therefore, is to use a recuperator instead of long flues, or better still use a thin or high-conductivity muffle which will keep the temperature gradient between the flues and the interior of the muffle as small as possible. This feature is conducive to economy, both as to muffle and fuel, since a lower temperature is necessary in the combustion chamber and flues in order to attain and maintain the proper enameling temperature within the muffle. There are furnaces in modern plants where the floors of the muffles are 8 to 12 in. thick with muffle walls 3 in. thick in which a temperature of 3,000 deg. F. (1,649 deg. C.) has to be maintained within the combustion chamber in order to maintain 1,600 deg. F. (871 deg. C.) in the muffle. Such a large temperature difference between the combustion chamber and muffle is not uncommon today and needless to say is not economical. A temperature difference of more than 400 deg. F. (204 deg. C.) between the flue temperature and muffle temperature is not justifiable in the light of the latest developments in porcelain enameling ovens.

Furnace Construction

In taking up the construction of furnaces for firing porcelain enamel let us first discuss the simplest form, the gas furnace. As is well known, the atmosphere within a porcelain firing furnace must be oxidizing—that is, must have an excess of oxygen present and little or no reducing gases such as carbon monoxide—in order that a smooth product may be obtained. Control of the atmosphere within a gas-fired furnace is easily accomplished and for that reason semi-muffles are frequently used in these furnaces. A semi-muffle is only that part

*Chemical Engineer, Chicago Flexible Shaft Co. Paper presented before Chicago Section, American Ceramic Society, Nov. 27, 1920.

of the muffle which goes to make up the bottom and sides —that is, without a top. Such furnaces are highly efficient as to fuel consumption and are as satisfactory as the full muffle when the operation is understood. A gas-fired furnace is less expensive than any other type, due to its less bulky construction.

Oil,- coal- and producer-gas fired furnaces all fall into one general class whether recuperative or not. These furnaces all require relatively large combustion chambers and full muffle construction.

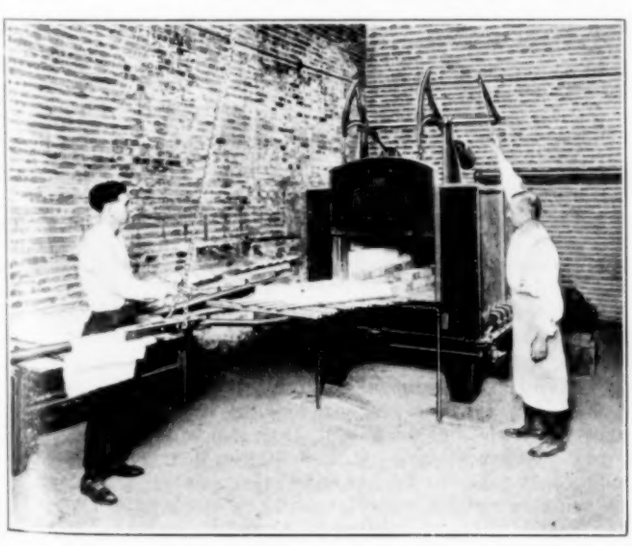
The general plan upon which all of this type are constructed is to build the combustion chamber or firebox under the rear of the furnace and erect a thick furnace floor over one long central combustion chamber, from the sides of which lateral flues lead to the flues in the wall of the furnace surrounding the muffle. This construction is surrounded by walls of refractory brick backed by several layers of red brick facing in order to conserve the heat. In such furnaces, which are exceedingly common, the temperature difference between the flue gases and the interior of the muffle is generally 800 deg. F. (427 deg. C.) or more, and to see flames emitting from the top of a 15-ft. stack attached to such furnaces is not uncommon. The heavy construction necessitated by the inherent weakness of the fireclay refractories at the temperature of an enameling furnace together with the poor thermal conductivity of these refractories results in a fuel consumption out of all proportion to the small percentage utilized in the burning of the ware. Any development in furnace design which will show a saving of several per cent in fuel will be a boon to the enameler, because his costs of production are gradually approaching his selling prices.

Latest Developments in Enameling Furnaces

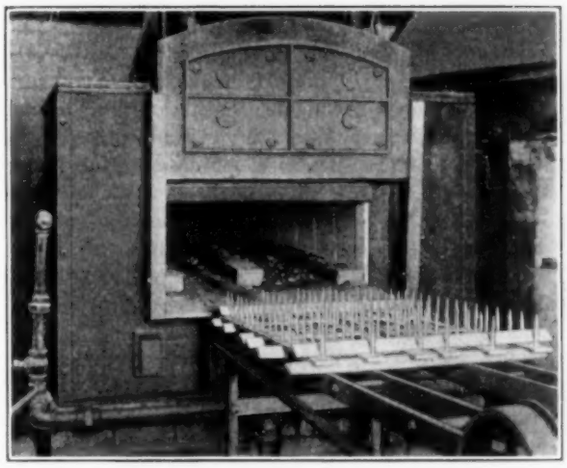
Before entering into a discussion relative to the latest developments in enameling furnaces it may be better to outline the points of weakness in the old types. For brevity we will itemize their shortcomings:

1. The weakness of the fireclay refractories at the temperature of enameling ovens necessitates the use of exceedingly heavy refractories with such mass as to require days to heat up, and definite control of the temperature of the furnace is impossible.

2. The poor conductivity of the heavy refractory muffles makes it imperative to maintain a flue temperature 800 to 1,000 deg. F. (427 to 538 deg. C.) in excess of the muffle temperature, resulting in high fuel consumption and short life of the refractories.



SEMI-MUFFLE, GAS FIRED



FULL MUFFLE, GAS FIRED

3. Great mass and poor conductivity of refractories. From three to five days is required to bring a furnace up to heat.

4. Uniformity of temperatures—i.e., plus or minus 10 deg. F. (—12 deg. C.) within the muffles of the old type furnace are almost unknown, and loading to the door can never be practiced.

5. High flue temperatures necessitate bulky construction in order to conserve the heat.

6. Economy of operation of old type furnaces cannot be practiced except at expense of output.

7. The durability or life of the old type muffle furnace is fairly short. Constant repairs and renewals are required and overheating results in its ruin.

8. Shutdowns over Saturday afternoon and Sunday are not practicable.

Now, having listed the shortcomings of the old type furnace, let us see how these are overcome in the new furnaces, point for point:

1. The carborundum refractories used in the newer furnaces, having a mechanical strength approximately ten times that of ordinary fireclay when cold and retaining this strength to and above the temperature of the enameling furnace, 3,500 deg. F. (1,767 deg. C.), whereas the fireclay weakens, permit the construction of a furnace and muffle very much lighter. The carborundum floor may be 2 in. thick, whereas fireclay floors average 8 in., and the carborundum muffle may be 1½ in. thick, whereas fireclay must be 3 in. thick.

2. The high heat conductivity of the carborundum refractories permits the operation of the furnace with a much lower temperature in the combustion chamber and flues. The thermal conductivity of carborundum is seven times greater than fireclay, and as one-half the thickness is used fourteen times more heat is conducted through the walls of the muffle, thus permitting a temperature difference between flue gases and muffle of only 200 deg. F. (93 deg. C.). This one factor gives an average fuel saving of about 30 per cent, not to mention the lengthened life of the refractories.

3. This lightened construction permits a quicker heat —in fact five hours on an average from a cold furnace is common practice with carborundum muffles; and furthermore this permits a certain amount of temperature regulation not possible in clay muffles.

4. Lower combustion temperatures permit less bulky

constructions, conserving the heat. Another factor in the conservation of heat in modern furnaces is the use of insulating bricks, such as Silocel and Nonpareil.

5. Due to the high conductivity of the carborundum muffle the furnaces are designed to give and to deliver uniform temperatures throughout the muffle. Loading to the door is common practice, which gives an increased capacity of full 35 per cent. In one case a carborundum muffle tested with a Leeds & Northrup optical pyrometer by three people gave twenty readings running from 1,790 to 1,800 deg. F. (817 to 822 deg. C.), a variation of only 10 deg. and a temperature difference barely perceptible to the eye.

6. The output of a furnace is directly dependent on the temperatures which can be maintained within the muffle. This is easily accomplished in a carborundum muffle, due to its high thermal conductivity. A 30 per cent saving is the general average realized.

7. The life of the present-day furnaces, equipped for any system of firing and built in accordance with the latest specifications, using carborundum refractories, is apparently unlimited. In fact we have never yet had one burn out or need repairing so are not in a position to say definitely just how long they will last. One furnace was overheated to about 2,800 deg. F. without doing any damage to the muffle. It benefited the muffle by burning in the cement joints. This muffle after eight months' constant use, with shutdowns over Saturday and Sunday, is as true today as when installed.

8. Shutdowns over Saturday night and Sunday are regularly practiced by users of carborundum muffles, as five hours is sufficient time to heat up to working temperature and three hours is not uncommon with oil-fired furnaces. The fuel saving is very appreciable—in fact one user shows where he has saved the entire cost of the muffle in 120 days through fuel economy exclusive of the fuel saving due to being shut down over Sunday.

Conclusion

In conclusion we may summarize the comparison of the old and new type furnaces:

OLD	NEW
1. Excessive mass and character of refractories necessitates three to five days for the furnace to heat up. No definite temperature control can be practiced.	1. Light weight and refractories of high conductivity permit quick heating; five hours' time is general practice on coal, three hours on oil furnaces. Definite control of temperature is practicable.
2. Poor conductivity of refractories makes imperative high flue temperature, with resulting loss of fuel and shortened life of refractories.	2. High conductivity of refractories permits lower flue temperature, thus saving in fuel and lengthening of life of refractories.
3. Slow, careful heating, incurring large expense.	3. Rapid heating, with lessened expense.
4. High flue temperature, necessitating bulky construction to conserve heat.	4. Low flue temperature permits less bulky construction, and use of insulating material further conserves this heat.
5. Temperature difference between flue gases and muffle average 800 to 1,000 deg. F.	5. Temperature difference between flue gases and muffle average about 200 deg. F.
6. Uniformity of temperature within 10 deg. F. is unknown and full loading impractical.	6. Uniform temperature within 10 deg. F. is not uncommon and loading to door regularly practiced.
7. Fuel economy cannot be practiced.	7. Fuel economy over old type averages 30 per cent or more.
8. Life of muffle uncertain and short overheating is ruinous.	8. Life of muffle indefinitely long, overheating not injurious.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Hydrogen Peroxide.—In the manufacture of hydrogen peroxide solutions for commercial purposes, it has long been the custom to react upon barium peroxide, BaO_2, with acids in the presence of water in various ways, thereby forming a barium salt and a solution of H_2O_2. Acids forming normally insoluble barium salts, such as phosphoric acid and sulphuric acid, are usually employed. As is known, nitric acid may be employed for this purpose, since barium nitrate is but sparingly soluble particularly in the presence of any free nitric acid. In the formation of any of these insoluble or sparingly soluble barium salts, however, the difficulty is that it is hard to secure any complete conversion of the barium peroxide in the presence of small amounts of water—that is, under circumstances which will give a tolerably strong solution of hydrogen peroxide. Robert Jacquelet, of Catonsville, Md., suggests treating BaO_2 with a 2.5 per cent solution of HCl and then adding strong nitric acid which precipitates barium nitrate and releases an equivalent amount of HCl to attack a further quantity of BaO_2. With proper operation there is no liberation of chlorine from the production of aqua regia and all the barium dioxide is utilized. The final result is a solution of hydrogen peroxide which may be of such a strength as to be the equivalent of 35 or 40 volumes of oxygen, this solution containing a small amount of dissolved barium chloride. The rest of the barium is found in the form of a crystalline nitrate, which may be subsequently utilized in known ways to reproduce barium dioxide and nitric acid. The barium nitrate, washed, pressed and dried, is a clean white powder. It may be sold as such. The hydrogen peroxide solution does not contain enough barium chloride in solution to interfere with its use for many purposes. If the operation is properly conducted, it will be stable and neutral. This solution may be treated in the usual way to obtain stronger solutions or to get pure hydrogen peroxide. (1,364,558; Jan. 4, 1921.)

Sulphuryl Chloride.—A good yield of sulphuryl chloride (SO_2Cl_2) is obtained by allowing sulphur dioxide and chlorine to react in the presence of one or more of the following catalysts: Esters which are formed from saturated aliphatic alcohols and saturated aliphatic acids containing only the elements C, H, O; triphenyl phosphate; tricresyl phosphate; eucalyptol, benzaldehyde; benzyl acetate. It is not necessary to use sunlight, ultra-violet rays or pressure with these catalysts. (1,364,738; Thomas H. Durrans, of Oxford, England, assignor to A. Boake Roberts & Co., Ltd., of London, England; Jan. 4, 1921.)

Method of Forming Refractory Articles.—In the manufacture of refractory shapes or abrasive stones from mixtures of silicon carbide or crystalline alumina and plastic clay it has been found necessary to use high pressure in order to extrude the mass through the dies. Unless the dies are lubricated, deformation and breakage occur. The problem of efficient lubrication may be met by mixing about 4 per cent of a saponified oil mixture known as petroleum grease with the abrasive-clay mixture before extrusion. (1,364,849; Albert H. Anderson, of Worcester, Mass., assignor to Norton Co.; Jan. 4, 1921.)

Purifying Benzanthrone.—In the production of benzanthrone—for example, by condensing anthraquinone and glycerine with the aid of sulphuric acid—the product obtained after removing water-soluble constituents is still impure. It contains unchanged anthraquinone, a red resinous substance and a material which is black when wet and brown when dry. According to Lloyd C. Daniels of Buffalo, N. Y., halogen derivatives of the simple aromatic hydrocarbons, particularly chlorbenzene, are adapted for use

as selective solvents with this mixture. The crude benzanthrone press-cake is extracted with hot chlorbenzene. After filtering, the solution is cooled to about 15 deg. C., when the benzanthrone separates in quite pure form. When the benzanthrone is accompanied by considerable amounts of unchanged anthraquinone, it is sometimes difficult to effect a separation, owing to the formation of a eutectic containing about 11 to 12 per cent anthraquinone and 88 to 89 per cent benzanthrone. If, however, the anthraquinone is less than about 11 per cent, the separation is easily made. (1,365,024; assigned to National Aniline & Chemical Co., Jan. 11, 1921.)

Alcohols, Esters and Ketones From Petroleum-Cracking Still Vapors.—All phases of the process for utilizing the waste vapors from petroleum-cracking stills described in CHEMICAL & METALLURGICAL ENGINEERING, vol. 23, p. 1230, Dec. 22, 1920, are treated in a series of patents covering the research work done by CARLETON ELLIS, of Montclair, N. J.; MORTIMER J. COHEN, of New York; MATTHEW D. MANN, JR., of Roselle, N. J., and ROBERT R. WILLIAMS, of Chicago, Ill. The unsaturated hydrocarbons in the vapors are absorbed at about 20 deg. C. in H_2SO_4 of 1.8 sp.gr. The acid liquor may be treated to yield a variety of products. Alcohols (chiefly isopropyl) are obtained by diluting with water, which hydrolyzes the alkyl hydrogen sulphate. The alcohols are separated by distillation or by extraction with suitable solvents. By adding inorganic salts of organic acids, such as calcium or sodium acetate, to the acid liquor esters are found. Electrolytic oxidation of the acid liquors gives ketones and fatty acids. (1,365,043 to 1,365,053 inclusive; assigned, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y., Jan. 11, 1921.)

Separating Nickel and Cobalt.—Nickel-cobalt ores of the type found in the cobalt district of Canada are brought into solution in the form of chlorides by any approved method. Iron is removed by treating the solution with chlorine, removing the excess of chlorine by means of air or otherwise, and then agitating with calcium carbonate or similar precipitant. If the chlorine has been completely removed, only iron is precipitated. The resulting solution, containing nickel and cobalt but free from iron, is then mixed with finely divided calcium carbonate (whiting, for example) and gaseous chlorine is bubbled through the pulp. If the solution is kept at a sufficiently low temperature, very pure black cobalt oxide is formed and practically all of the nickel remains in solution. (1,365,358; MARVIN J. UDY, of Kokomo, Ind., and OLIVER C. RALSTON, of Niagara Falls, N. Y., assignors to Hooker Electrochemical Co., Jan. 11, 1921.)

Phenols From Redwood.—Unlike most soft, resinous woods, redwood (*Sequoia sempervirens*) when destructively distilled gives a tar which contains large proportions of phenol and creosols. According to WALTER J. HUND, of Ross, Cal., one cord (4,000 lb.) of the light-wood from redwood stumps will give upon destructive distillation 50 to 60 gal. of tar (sp.gr. 1.11). This tar is then distilled. The fraction between 150 and 250 deg. C. is collected separately, giving from 20 to 25 gal. of middle oil, which is then treated with sodium hydroxide solution. Acidification of the alkaline extract gives 10 to 15 gal. of phenolic oils, which after fractionating and purifying yield 17 to 20 lb. crystalline phenol, 4 to 5 gal. cresylic acid and 2 to 3 gal. creosote. The absence of sulphur compounds and naphthalene simplifies the process. (1,365,407; Jan. 11, 1921.)

Recovering Volatile Solvents.—Vapors containing volatile solvents are treated with a mixture of sperm oil, lard oil, petroleum oil and alcohol. The solvent is subsequently separated from the absorbing agent. (1,365,791; SAMUEL S. SADTLER, of Springfield township, Montgomery Co., Pa.; Jan. 18, 1921.)

Glass.—A glass having a low coefficient of expansion and marked resistance to high and low temperatures is made from a batch consisting of a preponderance of silica, smaller amounts of boric oxide, alumina, sodium nitrate and sodium carbonate, and still smaller amounts of calcium carbonate and arsenic trioxide. (1,365,597; MAURICE A. SMITH, of Jeannette, Pa., assignor to McKee Glass Co.; Jan. 18, 1921.)

British Patents

Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Treating Gas Liquor to Form Fertilizers.—Gas liquor is freed from ammonium cyanide and sulphocyanide and rendered suitable for use as a fertilizer by adding yellow ammonium sulphide or sulphur or by treating it with air or other agent to separate sulphur from the sulphur compounds, and distilling the liquor. The cyanide is transformed into sulphocyanide which remains in the retort. (Br. Pat. 153,006; GES. FÜR LANDWIRTSCHAFTLICHEN BEDARF. and DR. I. R. MANDELBAUM, both in Munich. Jan. 12, 1921.)

Sodium Pentaborate—Boric Acid.—Boro-natro-calcite is treated with water or mother liquor and enough sulphuric acid to form calcium sulphate but without giving the mixture an acid reaction and the mixture is heated to 75 deg. C. and filtered. The filtrate is concentrated and cooled to obtain sodium pentaborate, $Na_2O, 5B_2O_3, 10H_2O$, and some boric acid remains in solution and may be recovered. The residue consists of calcium sulphate and unchanged boronatro-calcite. It is treated with water or mother liquor and enough sulphuric acid to make the mixture acid, and is then filtered. Calcium sulphate remains on the filter, and boric acid is recovered from the filtrate. (Br. Pat. 153,007; not yet accepted; SCHOTT & GES., Jena, Germany. Jan. 12, 1921.)

Anthraquinone Derivatives and Dyes.—Condensation products, probably azomethine compounds, are obtained by heating 1-amino-2-methylanthraquinone or its substitution products, or isomeric amino-2-methylanthraquinone, or 2-methylanthraquinone itself, with aromatic nitro compounds in the presence of alkaline reagents; primary aromatic amines may be added to the reaction mixture. The products are vat dyestuffs, and may be hydrolyzed by acids to give 1-aminoanthraquinone-2-aldehyde, or its substitution products or isomers, or anthraquinone-2-aldehyde, respectively. According to examples, condensation products are obtained by heating (1) 1-amino-2-methylanthraquinone with nitrobenzene and potassium carbonate or with nitrobenzene, aniline, and potassium acetate or caustic soda; (2) 1-amino-2-methylanthraquinone with *m*-nitroaniline, napthalene, and potassium carbonate; (3) 1-amino-methylanthraquinone with β-naphthylamine, nitrobenzene and potassium carbonate; (4) 4-*p*-toluido-1-amino-2-methylanthraquinone, nitrobenzene, aniline, and potassium acetate; (5) 1:5-diamino-2-methyl-anthraquinone, nitrobenzene, aniline, and potassium carbonate; (6) 3-amino-2-methylanthraquinone, nitrobenzene, aniline, and potassium carbonate; (7) 2-methylanthraquinone, nitrobenzene, aniline, and potassium carbonate. Examples are also given of the preparation of 1-aminoanthraquinone-2-aldehyde, 4-*p*-toluido-1-aminoanthraquinone-2-aldehyde, 1: 5-diaminoanthraquinone-2-aldehyde, 3-aminoanthraquinone-2-aldehyde, and anthraquinone-2-aldehyde from these condensation products. (Br. Pat. 153,055; L. CASELLA & Co., Frankfort-on-Main, Germany. Jan. 12, 1921.)

Catalyst for Synthetic Ammonia.—Catalysts for use in the synthesis of ammonia are prepared by heating, preferably to a temperature below 500 deg. C. in a neutral atmosphere, simple cyanides of the metals, iron, nickel, cobalt and chromium, or complex cyanides of such metals, not containing a cyanide or alkali or alkaline earth metal, or in which the molecular proportion of such cyanide to the heavy metal cyanide is less than 2:1; by the use of these catalysts the synthesis of ammonia can be carried out at a temperature below 400 deg. C. and while using a pressure less than 100 atmospheres. Suitable initial compounds are ferrous cyanide, ferrocyanhydric acid, ammonium ferrocyanide, triammonium-potassium-ferrocyanide, potassium-ferrous-ferrocyanide (Everitts' salts), potassium-ferric-ferro-cyanide (Williamson's violet). It is advantageous to add to initial materials not containing alkali or alkaline earth metals, a proportion of a compound of such metal, potassium nitrate for example, but the relative proportions here indicated must not be exceeded. (Br. Pat. 153,290; not yet accepted; NORSK HYDRO-ELEKTRISK KVAELSTOFAKTIESELSKAB, Christiania, Jan. 12, 1921.)

Current Events
in the Chemical and Metallurgical Industries

Engineering Foundation and Industrial Research

Industrial research on a nation-wide scale, in which engineering organizations, universities, factories, individuals and private laboratories and other organizations are co-operating, is under way, according to the annual report of Engineering Foundation, prepared by the chairman, Charles F. Rand.

Describing the Foundation as a permanent national agency "for the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind," Mr. Rand outlines a broad field of activity in which the Foundation, profiting by the lessons of the war, is working.

Highway research, experimentation in the fatigue phenomena of metals, mental hygiene in industry, industrial personnel research, psychological tests for engineering students, industrial education in training, and tests of mechanical equipment are among the projects which the Foundation's effort embraces.

The Foundation, according to Mr. Rand, now has an endowment of $500,000. One anonymous gift of $200,000 has been received and one individual, it is stated, has offered to give $50,000 if nine other men would make equal gifts.

To avoid a possible deficit of $16,000 by 1922 Edward D. Adams of New York assumed this contingent liability. Mr. Adams' liability has now been canceled, the financial requirements for the work in hand having been provided by the increased income from endowment. The Foundation is raising a fund of many millions to promote industrial research in America and hopes this year to reach the five million dollar mark.

Many new projects with design to foster research and thus help maintain this country's industrial supremacy are under consideration by Engineering Foundation. Among the specific researches suggested are: Cryogenics, particularly research in characteristics of gas mixtures in relation to liquefaction and separation of gases for industrial purposes; electrical insulation; collodial lubricants and fundamental principles of lubrication; fundamental study of laws of crystallization of metals, atomic structures and other metallurgical problems; improvement of utilization of all kinds of fuels; principles of heat transfer; landslides; ceramics; hydraulics; industrial education and training; and social industrial engineering.

"Establishment and operation of a large hydraulic laboratory has been suggested as an appropriate undertaking for Engineering Foundation," declares the report. "It has also been proposed that the Foundation establish and conduct an Engineering Research Institute and Laboratory, to supplement the university training of promising research men, to provide place and means for research by engineers and inventors and for limited co-operative research by the industries, and to house models, apparatus and drawings of historic interest in connection with engineering research. The proposed laboratories could be made partly self-sustaining, but very large funds would be needed for their establishment and to supply the deficiencies in income.

"Another suggestion is that Engineering Foundation conserve research byproducts of engineering works. Engineering works frequently involve studies of special problems or in themselves constitute full-sized experiments, which could be made to yield important data. Sometimes the engineers in charge do not perceive the opportunity, not having been trained in research work. More often the possibilities are realized, but means, men and time cannot be used because of the commercial urgency for getting the project completed with minimum expenditure. Occasionally experimental work is undertaken in accordance with a well conceived plan, but the exigencies of the main operation sooner or later interfere, or the information is gained but never made available; a greater familiarity with research methods and a broader conception of the problem could, with small additional expense, have secured much more valuable results and have made them more generally useful."

Kelly-Springfield Tire Co. Moves to Cumberland

After a survey of the entire country the Kelly-Springfield Tire Co. selected a 100-acre site along the Potomac at Cumberland, Md., for a model plant to have a capacity of 10,000 tires a day, including 1,500 truck tires. The business of the old plants at Akron, Ohio, Wooster, Ohio, and Buffalo, N. Y., will be transferred to the new factory, which will be ready for operation about April 1.

The new location is most satisfactory with respect to transportation, labor, raw materials, water and power. Three trunk line railroads serve the plant, and the location has a 10 per cent freight differential over Akron. An abundant coal supply is available within eleven miles.

The main building has a floor area of twenty acres. The main wing, 760 x 120 ft., two stories, is joined by five wings, each 305 x 60 ft. From receipt of raw material to shipment of finished product, one progressive movement is maintained in the process of manufacturing. Machinery includes three 90-in. calenders, the largest ever built, and two pumps with an approximate capacity of 6,000,000 gal. each. Power is furnished for six 750-hp. boilers. Future expansion is provided for in every phase of the layout.

The laboratory or experimental building, two stories, 300 x 55 ft., is said to be the only one in the industry in which a complete standard tire can be built. It contains the most modern equipment for chemical and mechanical development.

Plans for Chicago Convention of American Mining Congress

The twenty-fourth annual convention of the American Mining Congress and the National Exposition of Mines and Mining Equipment will be held in Chicago, Oct. 17 to 22 inclusive, with convention headquarters at the Congress Hotel. The Coliseum has been reserved for the exposition which will include exhibits of: Coal byproducts, chemicals, non-metalliferous substances, petroleum, oil shale, cement and cement products, raw and manufactured products, byproducts, smelting equipment, flotation and milling equipment.

Among the national conferences to be held during the convention will be those on Taxation, Production and Cost, Labor, Transportation, Standardization, Flotation, Gold Production, the Commercial Development of Byproducts, the Development of Non-Metalliferous Ores, National Finance, Mine Management and Handling of Men, Mineral Tariffs, etc. National leaders will discuss the present-day tendency toward government control of industry.

Crescent Refractories Co. Merger

Following the annual stockholders' meeting of the Crescent Refractories Co. of Curwensville, Pa., announcement was made of a merger of the George S. Good Firebrick Co. and the Clearfield Clayworking Co. with the Crescent Refractories Co.'s properties. Consolidation of these properties brings together three important Clearfield County fireclay and coal holding properties.

The output of the plants now operated by the corporation reaches 240,000 brick per day and marks another step forward in fireclay industry of this region.

New Jersey Clay Workers Defer Annual Meeting

At a meeting of the executive committee of the New Jersey Clay Workers Association and Eastern Section of the American Ceramic Society at Metuchen, N. J., March 5 it was voted to pass by the annual meeting of the organization, originally planned for January, but at which time it was impossible to arrange for the gathering. The next meeting will be held in June at Trenton, and it is proposed to make this midsummer gathering an important event. A committee has been appointed to arrange the details of the convention and fix a definite date. Another committee was selected to draft a set of new bylaws for the organization, to conform more closely to the constitution of the American Ceramic Society. Plans were also discussed for the new official publication of the organization, to be known as the *New Jersey Ceramist*, which will be issued quarterly. Charles Howell Cook, Trenton, chairman of the executive committee, presided at the meeting, with R. H. Minton, vice-chairman, acting in his stead prior to adjournment. Among those present were Abel Hansen, Perth Amboy, chairman of the association; Prof. George H. Brown, Rutgers College, secretary and treasurer; Charles A. Bloomfield, councilor, and representatives from the Mercer County and Raritan River sections.

Muscle Shoals Fight to Continue

Failure on the part of Congress to approve the $10,000,000 item in the sundry civil bill intended for the continuation of the work on the Wilson dam at Muscle Shoals by no means ends the fight on this proposition. The development of Muscle Shoals and the disposition to be made of the nitrate plants at that point furnished the subject for acrimonious controversy throughout the greater part of the session of Congress which just has closed. Despite the approval of the Fixed Nitrogen Corporation bill by the Senate on Jan. 14, further progress of the measure was blocked in the House. This was comparatively easy because the amendments attached by the Senate would have made the proposed corporation almost unworkable.

Controversy Over Wilson Dam Appropriation

No sooner had the fight over the Fixed Nitrogen Corporation bill lulled than there arose the fight to appropriate for continuing work on the dam. The Committee on Appropriations of the House refused to include the item in this bill. Efforts to insert it on the floor were unsuccessful. The Senate, however, put the appropriation into the measure and retained it by decided majorities on two record votes. For a time it seemed that the sundry civil bill, carrying more than $400,000,000, would fail of passage because of the controversy over the Muscle Shoals item. It was not until the closing hours of the session that the matter finally was settled when Senator Underwood withdrew his opposition, stating that there was nothing to be gained by causing the bill to fail. Each side to the controversy alleged that powerful lobbies were at work. The "fertilizer trust" and "the powder trust" were declared to be behind one lobby, while the other side said that the Alabama Power Co. was sponsoring the lobby which was supporting the item. Senator Underwood, in one of his statements on the floor of the Senate, said:

> Seventeen million dollars was allocated for the purpose of building it; a large portion of that money has already been spent; and to abandon the project is to throw that money away. The testimony of the greatest engineers in America confirms the statement that this is an excellent undertaking; an undertaking that will safely return to the Government the money invested. It comes in the usual way, with an estimate from the Government to carry on the work; and the reason it is defeated is because a lobby, representing special interests, fighting for their own pocketbooks, regardless of the national defense and the interests of the national Government, have injected their fangs into the body of this legislation and torn this appropriation out of it. There is no man who knows the conditions that have confronted this proposal but that knows that is a fact. I will not call the names now, but if their names are wanted or if it is ever desired to investigate this question in the future I can name the men who have haunted the Capitol and the hotels in the city of Washington lobbying against this proposition because they thought it might interfere with their private business, putting their own dollars above the integrity of the Government of the United States, its honor and its safety.

Senator Lenroot, of Wisconsin, was the most active opponent of the appropriation. He declared it to be a foray on the part of the Government into the field of private enterprise. He asserted that the Alabama Power Co. would be the chief beneficiary of the improvement.

Senator Underwood met this charge by stating that chemical and other industries would quickly locate at Muscle Shoals, once that the power became available, as they had done at Niagara Falls. He pointed out that at first there was much doubt expressed as to whether use could be found at Niagara Falls for 60,000 hp. His whole contention is that the development of this water power, which is capable of producing more power than is the present diversion on the American side at Niagara Falls, would be of immeasurable benefit to the country as a whole. He characterized it as unthinkable that the Government should throw away its investment of $100,000,000 in view of the value of the project to the industries and in the matter of the national defense.

Work on Dam to Be Discontinued

In view of the failure to appropriate for continuing the work, the Corps of Engineers has issued instructions that all work be discontinued except in two cases where a great sacrifice would be involved were the work to stop at this time. At Jackson Island the work will continue until the cofferdam can be removed. There will remain about $1,000,000 of the existing appropriation, which will be sufficient to look after the maintenance work until August, 1922, which is the earliest date that an appropriation is likely to be made available.

Chemical Warfare Service Criticized and Defended

The efforts of the War Department to develop chemical warfare prior to and following the armistice are criticized scathingly in one of the final reports by the select committee on expenditures in the War Department, of which Representative Graham of Illinois is chairman. An opposite position on chemical warfare is taken by the minority members of the committee.

In the majority report it is stated that nearly all the chemical warfare equipment which the United States used in the war was purchased from the Allies. This, it is said, applied to gas itself except in the latter months of the war. The report further states that American-made equipment did not reach France in time to help win the war.

The minority declares that the principal purpose of the majority is to "find something on which to base the criticism of the administration of our armies" and "is biased, erroneous and totally misleading" and "an example of ingratitude to those who bravely did their duty in the nation's great crisis." It is claimed that most of the criticism will fall of its own weight and that consequently no effort will be made to refute each of the allegations.

Civil Service Examination

An open competitive examination for pyrotechnic assistant is announced by the United States Civil Service Commission. A vacancy at Picatinny Arsenal, Dover, N. J., at $1,872 a year, is among those to be filled from this examination. Applicants must have graduated from a four years' high school course (or its equivalent) and have had at least one year's experience along the line of pyrotechnic material. Experience in flying and acquaintance with the present equipment and devices used by the aircraft divisions of the War Department for signal work are desirable, but not essential. Applications will be received on Form 1312 until the hour of closing business on April 5, 1921.

Vanadium Plant Closed

The Chemical Products Co., of Denver, Col., engaged in the production of vanadium, with radium as a byproduct, has discontinued operations indefinitely. The cause given is the poor market for vanadium.

University of Wisconsin Chemistry Students to Make Their Own Chemicals Next Summer

To reduce the cost of chemicals needed for research work in various scientific departments of the University of Wisconsin, the chemistry department will give a new course in the manufacture of organic chemicals during the summer session under the direction of Prof. Glenn S. Skinner. There is only one other institution giving a course of this nature in the country, it is claimed.

All scientists in the university have been asked to leave their orders for chemicals with Prof. Skinner and as far as is possible these orders will be filled by his course.

Only eight advanced students will be admitted to the course and they will work from nine to ten hours a day and will receive about 40c. an hour for their work. Only the most promising graduates and upper classmen will be selected for the work, with the view of giving them intensive training in practical organic chemistry and experience in larger scale operations.

Co-operative Work on Ceramics Planned

An arrangement for co-operative work between the Bureau of Mines and several of the associations of brick manufacturers is being planned, it is understood. It seems probable that the Bureau of Standards also is to be a party to the contract. The proposition involves obtaining a substantial sum which will make possible experimentation in a number of the fundamental problems encountered in the making of brick. The associations concerned are: The Face Brick Manufacturers Association, the American Common Brick Manufacturing Association, the National Paving Brick Manufacturers Association, and the Hollow Building Tile Manufacturers Association.

British Optical Glass and Scientific Instrument Bill

A bill which contains the following features has been prepared by the British Optical Instrument Manufacturers Association for consideration in Parliament:

1. No optical glass or scientific instruments to be imported into this country for a period of, say, seven years, except under license.
2. Such licenses only to be granted in respect of goods which are not being made in Great Britain in the required quantities or of the required quality.
3. An expert licensing committee to be set up.
4. The optical instrument manufacturers are prepared, in order to guarantee reasonable prices, to submit to a control of profits.

New Sulphite Pulp Mill for British Columbia

H. S. Taylor, chief engineer of the Mead Engineering Co., has made an examination of the site and timber limits of the Prince Rupert Lumber Co. of Prince Rupert, B. C., which has recently formed a subsidiary company, known as the Prince Rupert Pulp & Paper Co. The company is arranging for the erection of a sulphite pulp mill at a cost of $1,000,000 and it has made satisfactory arrangements with the city council with regard to taxation and water privileges.

British Columbia Oil Refinery to Resume Operations

C. M. Rolston, local manager for the Imperial Oil Co., Vancouver, B. C., has announced that arrangements have been made with California oil interests for the delivery of 600,000 bbl. of crude oil during the present year, and as soon as this oil commences to arrive the refinery at Ioco, near Vancouver, will be restarted. It was expected that the refinery would remain idle until June, when delivery of oil from Mexico had been arranged for.

Bureau of Standards Standard Samples

Renewal 5d of the exhausted standard iron sample C and renewal 10c of the exhausted standard bessemer steel 0.4 carbon are now ready for distribution with provisional certificates. The price of these standards is $2 per 150 g. and samples will be shipped by parcel post C.O.D. upon application to the Bureau of Standards, Washington, D. C.

Pottery Firm Reduces Working Force

The Coors Pottery Co., of Golden, Col., manufacturer of chemical porcelain, recently laid off about sixty employees.

Book Reviews

ELECTROLYTIC DEPOSITION AND HYDROMETALLURGY OF ZINC. By *Oliver C. Ralston;* 201 pages, illustrated. New York: McGraw-Hill Book Co. Price $3.

The author has concisely covered this interesting subject in an up-to-date little book. It is only in the last seven years that the electrolytic method has been a commercial success. As pointed out by E. P. Mathewson at the February meeting of the American Institute of Mining and Metallurgical Engineers (New York), electrolytic zinc production has now reached a stage where the furnace methods are doomed to extinction. While the electrolytic refining of zinc products and the precipitation of zinc from chloride solutions after chlorinating of zinc ores are discussed, most of the text is devoted to the electrolytic precipitation of zinc from sulphate solutions obtained by leaching roasted sulphide ores in dilute sulphuric acid. The latter method is the only one now on a commercial scale.

The author points out that the "roasting department is not merely a place in which zinc sulphide ores can be roasted to make zinc soluble, with little care or thought, but that careful control is necessary to prevent spoiling the ore for leaching purposes and in order to keep the plant supplied with just the right amount of sulphuric acid." The leaching and purification cycles are explained, and the steps required to remove the harmful impurities are covered at length. Detailed discussion is given of tank-house practice, including the effect of current density, temperature, acidity, circulation and impurities upon the nature of the zinc deposit and upon current and energy efficiencies. Much emphasis is rightly placed on the necessity of a pure electrolyte. Many references are given to various plants such as the Judge, the Anaconda (Great Falls) and the Trail plant in British Columbia. The two latter are the most important commercially and are referred to repeatedly by the author to explain details of operation and equipment. For those interested in this growing electrochemical process the book will serve as a ready and modern reference.

CHARLES H. ELDRIDGE.

* * *

PROCEEDINGS OF THE CHICAGO MEETING OF THE INDUSTRIAL RELATIONS ASSOCIATION OF AMERICA. Industrial Relations Association of America, 564 Main St., East Orange, N. J. 592 pp. Price $5.

The standard method of dealing with proceedings of technical societies is to put them on the bookshelf in the expectation of referring to them at some future time, quite frequently with the result that the paper turns yellow with age but the margins are unsullied with finger marks. But this volume of the proceedings of the Chicago meeting of the Industrial Relations Association of America simply refused to be handled in this way. Those who attended the meeting must have devoted at least four or more days' time to it and expended a corresponding sum of money. The unnamed person who compiled the record of the proceedings has contrived to commit to print so much of the spirit of the gathering and of the worthwhile discussion that for the price of a room for one night in a Chicago hotel anyone may have a fairly good knowledge of what happened. The reviewer has been carrying the volume around for weeks, knowing he should write his review but wanting always to get time to read some, because every page he had scanned had had something of interest. The principal speakers dealt with incentives and production, linking up the worker with the finished product, the foreman, organized labor, what the worker, and what the management wants. There were sectional meetings on banks, chemical industries, department stores, lumber, metal trades, packing industries, railroads and the steel industries. Of subject meetings, there were about thirty, running the gamut of the alphabet from Americanization to wage levels, so that everyone interested in industrial relations is sure to find something useful to him and to make him resolve that, if he can arrange it, he will attend the next meeting of the association.

T. T. READ.

Personal

Dr. JAMES ROWLAND ANGELL was elected president of Yale University by the Yale Corporation at its meeting on Feb. 20.

Dr. RAYMOND F. BACON spoke at the meeting of the Southern Naval Stores Association at Georgia Tech., Atlanta, Monday, March 14, on the possibilities of developing a pine oil and rosin industry with modern research.

ROBERT R. DREISBACH has resigned as chemical engineer with the Dow Chemical Co. to accept a position with The Barrett Co., Frankford, Pa., in connection with production and development work.

J. CLAIRE EVANS, vice-president of the Denver Fire Clay Co., was in New York City and other Eastern points recently on business.

ANDREW M. FAIRLIE will lecture before the Franklin Institute, Philadelphia, on March 16 on "Recent Developments in the Manufacture of Sulphuric Acid."

E. A. GOODHUE, who has been a teaching fellow in chemistry at the California Institute of Technology for a year, has resumed his duties as instructor of chemistry at the University of Vermont, Burlington, Vt.

ROBERT W. HILTON, formerly manager of the Ault & Wiborg dye plant at Norwood, Ohio, is now in charge of the company's ink works.

JOSEPH S. REICHERT, for the past two years supervisor of production in the edible products department at the Ivorydale plant of Procter & Gamble Co., Cincinnati, Ohio, has accepted the appointment as professor of general and industrial chemistry at the University of Notre Dame, Notre Dame, Ind.

Dr. H. ROSSBACHER, who was formerly chief chemist of the Chicago Paving Laboratory, is now research chemist for the Western Electric Co.

C. C. SMITH, assistant secretary of the American Petroleum Institute, has resigned to accept a position as manager of the New York office of James B. Berry's Sons Co., Inc. Mr. Smith was made assistant secretary of the Institute at the time of its organization. Prior thereto he had been assistant secretary of the National Petroleum War Service Committee. In both positions he rendered conscientious and intelligent service, and leaves his work with the Institute with the esteem and confidence of the staff and the board of directors. Mr. Smith will continue to be assistant treasurer of the Institute.

E. R. WILES, who until last fall was in the employ of Cosden & Co. as assistant chemist in charge of analytical work, is now chief chemist of the Southern Oil Corporation at its refinery at Yale, Okla.

At the annual general meeting of the Faraday Society, London, the following officers were elected to serve for the coming year: President, Prof. A. W. Porter; vice-presidents, W. R. Cooper, Prof. C. H. Desch, Dr. J. A. Harker, Emil Hatschek, Prof. T. M. Lowry, Dr. E. H. Rayner and Dr. G. Senter.

Obituary

JOHN D. PENNOCK, general manager of the Solvay Process Co., died suddenly on March 11 at Syracuse, N. Y., upon his return from a vacation in South Carolina. Mr. Pennock was born at Morristown, Vt., in 1860, was graduated from Harvard in 1883, and was an instructor in chemistry there during the following year.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, March 14, 1921.

The recent acquisition of German territory and industries by the Allies has caused an increased call for several important chemicals which had recently been bought from Germany. It now seems probable that the Allies will control German exports and seize a substantial amount of them and consumers who thought that they had bought wisely from Germany at lower prices than procurable here were greatly perturbed over this action. Among the items in demand were *bichromates, oxalic acid, caustic potash, muriate of potash* and *chlorate of potash.*

Aside from this sudden change the chemical industry in general has reflected the economic conditions which prevail in every important trade at present. The movement, while fair in some commodities, has been sluggish in others and buyers still are contented to operate on a conservative basis pending improvement, which they feel is not a long way off. While there has been some increase noted in the sales of large producers, the demand is far below normal and rumors are current regarding a further decrease in production. The cost of some of our basic chemicals is now so low that further downward revisions in prices without a proportionate reduction in the cost of manufacturing might prove quite ruinous.

Pressure of resale material has been felt at intervals and the need of ready cash has occasionally caused dealers to sacrifice values to insure an immediate sale. It seems reasonable to believe that with the restricted production now in effect and the gradual absorption of spot stocks the situation will eventually right itself. Some inquiries have reached the market from textile mills, but it seems that tanneries are still idle buyers. Paper mills have taken on bleaching powder for near-by and future shipments. Soapmakers have shown an added interest in oils and fats, but have not been purchasing chemicals to any noticeable extent. Glassmakers appear to be well covered by standing contracts and the call from these interests is sufficient to keep dense soda ash in light supply.

EXPORT BUSINESS DULL

The export business remains dull. Inquiries for miscellaneous chemicals are in the market quite frequently, but the deflation of exchange rates has prevented business. Another great barrier to foreign trade is the credit situation. Foreign buyers require ninety days credit and our banks are unwilling to discount these drafts. Supplies of chemicals in foreign hands are not believed to be heavy. Liquidation has been going on in foreign countries as well as in America.

There is a strong feeling of confidence in the new administration at Washington. Industry is looking forward to a sound constructive policy and an expansion of confidence ought to be reflected in exchange rates. This in itself should serve as a great remedy to the present depression.

Domestic prime white *arsenic* is quoted at 10@11c. per lb., according to quantity and time of delivery. Resale lots of foreign material have reached the market at somewhat under this figure, while prompt shipments from abroad were quoted at 8c. per lb. Prominent sellers are looking for a marked improvement in the consuming demand, as some of the leading insecticide manufacturers have not covered their requirements. Sales of *muriate of potash* have been reported from $60@$70 per ton, basis 80 per cent, delivered. The inside price records a decline and rumors were heard that sales had been made at further price reductions. Competition between foreign and domestic sellers is having a depressing influence and the tendency of price is described as easy.

Resale transactions in solid *caustic soda* during the week were reported at figures ranging from $3.60@$3.75 per 100

lb. Rumors were current that isolated lots under stress pressure sold below the inside price, but sellers as a rule gave $3.60 as the minimum trading figure for spot material. Although an occasional carlot of *soda ash* was sold at $2 per 100 lb., most dealers were not inclined to shade $2.10 and some sellers were asking up to $2.15. The inquiry for double bags has remained very quiet and the market was quoted nominal at $2.10 per 100 lb. Ash in barrels seemed to be most in demand and sales were reported as high as 2¼c. per lb. Offerings were very light in all directions and the tone of the market appeared quite firm. Foreign *prussiate of soda* had a depressing influence on spot quotations and prices declined from 15c. to 14c. per lb. The buying power was not accentuated and consumers preferred to operate on a hand-to-mouth basis. Factors in domestic prussiate were not eager to quote owing to the quiet extent of inquiries, but intimated they would meet any competition if the occasion required.

Sharp reductions were announced in prices on *methanol* by producers. Pure methanol is now quoted at $1 per gal. in tank cars, the 95 per cent at $1.12 per gal. in barrels, and the Columbian spirits at $1.35 in barrels. *Ethyl alcohol* is in easy supply at $4.75@$5 per gal. Denatured is moving in small lots, while prices are somewhat irregular, with a range from 42@54c. per gal., depending on the formula.

Coal-Tar Products

Some improvement in trading could be noticed in the coal-tar products market during the past week. The degree of improvement is not very great, however, as consumers still look for lower prices and will come into the market only for short time supplies. Prices have shown an easy tendency and shading is practiced in various quarters. Intermediates have moved in better volume and prices have shown no radical changes. Consumers of *aniline oil* seem to be in good supply and while stocks are plentiful prices are fairly steady at 22@26c. per lb. A fair movement is reported in *beta naphthol* at 34@40c. per lb. The market on *paranitranaline* is not very active, but prices are steady at 90c.@$1.05 per lb. The crude products, such as *benzene*, *naphthalene* and *phenol*, have shown a greater activity of late. *Naphthalene flake* prices are steady at 8½@9c. per lb. and trading is said to be in fair volume in most quarters. There is little activity in the market for *para-dichlorbenzene*. The consuming demand is of a light routine nature and prices are holding steady on a basis of 15@20c. per lb. The demand for *diphenylamine* continues along routine lines and for quantities only sufficient to meet present needs. There has been no recent change in the price level at 60@70c. per lb., depending on quantity.

Rubber

The tone of the crude rubber market was slightly easier, and while intimations were made that prices could have been shaded in some quarters no actual changes were recorded. *Spot ribbed smoked sheets* were offered freely at 17½c. per lb., but inquiries were few and commanded but little attention. *First latex spot* was named at 19½c. per lb. asked and 19¼c. on firm bids. Futures on *ribs* were subject to little demand. April, May, June sellers were asking 19¼c., but as far as could be ascertained no business was done. July-September was also a dull affair and remained quoted at 22½c. per lb. October, December sellers were few. Trading in general during the week was of an extremely small volume and little encouragement was offered in any direction.

Waxes

The market for crude *beeswax* was quiet, but prices held fairly steady basis. African crude was quoted from 17@19c. per lb., depending upon quality and seller, with the Brazilian at 23@25c. per lb. Refined beeswax was nominal at 27@30c. per lb. Prices on *carnauba wax* varied but little during the past week, reflecting a steady position at primary markets. The higher grades on the spot are in rather light supply and prices named are more or less nominal. Offerings of the common sorts are plentiful and slight irregularity in prices is named by importers. For No. 3 North Country quotations held at 18@19c. per lb.

Demand for *Japan wax* was routine only, but with importations smaller prices were well maintained at 19@20c. per lb. The tendency of prices in the market for *paraffine wax* was downward during the past week. New business placed was not up to expectations, the export inquiry being particularly slack. Refiners offered scale wax, 124-126 deg. melting point, in carlots for immediate shipment at 2¾c. per lb. and it was reported that actual business had been placed at this figure. Fully refined, 130 deg. melting point, was nominal at 6c. per lb.

COMPARATIVE LIST OF GENERAL CHEMICALS

Article	January, 1921	February 1921	March 1921
Acetic acid, glacial	$0.10	$0.10	$0.09
Muriatic acid	.0185	.0175	.0145
Oxalic acid	.18	.17½	.15
Tartaric acid	.39	.33	.32
Ammonia alum, lump	.04½	.04½	.04½
Potash alum, lump	.05½	.05½	.05½
Alumina sulphate, iron free	.03½	.03	.03
Alumina sulphate, comm	.02½	.02½	.02½
Salammoniac white	.10½	.08	.07½
Arsenic white powd	.11	.10	.09
Barium chloride, ton	75.00	70.00	65.00
Bleaching powder	.03½	.03	.02½
Carbon tetrachloride	.11	.12	.10
Cobalt oxide	4.00	4.00	3.00
Copper sulphate	.06½	.06½	.05½
Cream of tartar	.40	.32	.30
Epsom salt, U.S.P.	.03	.02	.02½
Formaldehyde	.18½	.18	.17½
Glauber salt	.01½	.01½	.01½
Lead arsenate, paste	.11	.11	.11
Nickel salt, single	.13	.13	.13
Bichromate potash	.19	.15	.13
Carbonate potash	.11	.10	.08
Caustic potash, 88-92%	.14	.13	.10
Muriate potash, ton	75.00	75.00	60.00
Nitrate potash	.11½	.11½	.09½
Permanganate potash	.70	.55	.45
Prussiate potash, yellow	.32	.26	.28
Acetate soda	.05½	.05½	.05½
Soda ash light	.0190	.0210	.0210
Benzoate soda	.75	.75	.70
Bicarbonate soda	.09½	.08½	.08
Caustic soda, solid	.03½	.04	.0360
Chlorate soda	.11	.10	.10
Cyanide soda	.18	.19	.20
Fluoride soda	.19	.17	.13
Nitrate soda	.0285	.0285	.0280
Nitrite soda	.06½	.06½	.06
Prussiate soda	.17	.16½	.14
Salsoda	.02	.02	.0190
Silicate soda 60 degree	.0290	.0290	.03
Silicate soda 40 degree	.01½	.0115	.01½
Sulphide soda	.05½	.05½	.05
Sulphite soda	.04	.04	.04
Tin oxide	.50	.48	.45
Zinc chloride	.11½	.11½	.11
Zinc sulphate	.03½	.03½	.03½

The Iron and Steel Market

PITTSBURGH, March 11, 1921.

An analysis of the American Iron and Steel Institute's report covering the steel ingot production of thirty steel companies in February indicates that the rate of steel ingot production by the whole industry in February was about 25,200,000 gross tons per annum, or about 48 per cent of the actual productive capacity. The Steel Corporation operated at an average slightly above 75 per cent and the independents at slightly above 25 per cent. The Steel Corporation's rate this week is lower, about 60 per cent, while the independents are probably a trifle under 25 per cent.

If all that has occurred in production were to be ascribed to the influence of the price-cutting campaign inaugurated by independents early in February it could be said that the independents did not improve their position, while the Steel Corporation lost very considerably in production. The corporation operated at about 90 per cent in January, while the independents operated at about 28 per cent. However, both the corporation and the independents were in line for decreasing production if prices had remained steady, as there was very little buying and old orders were being worked out. The fair conclusion is that the price cutting saved the independents from any considerable decrease in operations, while it caused the Steel Corporation's operations to decrease at a greater rate than would otherwise have been the case. All observation tends to show that the Steel Corporation has not lost any customers to independents by the price cutting, but that its customers have in many cases been moved to curtail or shut off their receipts of steel from the corporation.

Steel Corporation Tonnage

The Steel Corporation's unfilled tonnage obligations at the end of February, as reported yesterday, amounted to 6,933,867 tons, the smallest amount since late in 1919. The de-

crease during February was 639,297 tons, this comparing with decreases of 574,958 tons in January and over 800,000 tons in each of the two preceding months. The February decrease was 51 per cent of the month's capacity, while shipments in February may be estimated at 75 per cent of capacity, making the net bookings the difference between these, about 24 per cent. The net bookings would be made up of total bookings minus cancellations, but there is no reason to suppose there were any cancellations of consequence. That matter seems to have beeen taken care of in the Dec. 31 statement. That the corporation had any bookings when the independents were cutting prices and the corporation was rigidly adhering to the price schedule is explained by the fact that the corporation's customers value a place on the corporation's order books. In 1920 their allotments saved them a great deal of money on account of independents having advanced their prices far above the corporation level.

Steel Prices

Perhaps there is a new trend in steel prices. Certainly the independent steel market is not moving in regular form pursuant to there having been a break a month ago. Prices should either be continuing to sag at this time or should have developed a definite level showing signs of strength, and neither of these is the case. On the whole the lowest prices being done by independents are not noticeably lower than those of a week ago, while there certainly is no market stability. Some extreme low prices that were spoken of a week or two ago as a possibility are not now mentioned, as, for instance, 1.85c. for bars.

As to the attitude of steel buyers, that is perfectly clear. The buyers as a class are not interested. It is not a case of prices not having gone down sufficiently to suit buyers, for the buyers do not know at what price they could place really attractive orders. The mills have been quite willing to listen to bids, whether or not they would accept them, but the bids have not been made. In circles outside the steel industry it is being suggested that the Steel Corporation should reduce its prices, there being the apparent assumption that this would bring buyers into the market. There is no basis in steel market experience for any such assumption.

As to the attitude of the independent steel producers, there is some disposition to withdraw from the price-cutting operation, though there is no definite movement back to the old, or Steel Corporation, schedule. There is merely a chance that such a movement may occur.

Finally, as to the Steel Corporation's attitude, the corporation has not reduced prices or wages. It has been well settled that the corporation would not reduce one without the other. The corporation refuses to be influenced by what the independents have done. It elects to be independent.

Elimination of the 12-Hour Workday

From Judge Gary's statement made early this week it may be deduced as a probability that the Steel Corporation will act upon the wage matter in about thirty days and that the action will involve elimination of the 12-hour workday. If this long-expected change is made the balance of probability is that there will not be straight substitution of an 8-hour shift. There have always been strong objections to that course, two of the objections being that eight hours is too short a time from start to finish, and that most of the men are not in continuous employment during their hours on duty. The difficulty has been to arrange for continuous operation with a system that lies between straight two shifts and straight three shifts. That a compromise ground is being sought is evidenced by the fact that the committee in charge of the matter, composed of no less than the presidents of subsidiary companies, has been hard at work and cannot yet report.

There is a possibility that the corporation may make a change in rates and working conditions that will not reduce the wage cost of producing a ton of steel, and in that event price reductions would not necessarily accompany the change.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	.....	$0.55 - $0.60
Acetone	lb.	$0.13 - $0.13½	.13½ - .14
Acid, acetic, 28 per cent	100 lbs.	3.00 - 3.25	3.50 - 3.75
Acetic, 56 per cent	100 lbs.	6.00 - 6.25	6.50 - 6.75
Acetic, glacial, 99½ per cent, carboys,	100 lbs.	9.00 - 9.50	10.00 - 10.50
Boric, crystals	lb.	.14½ - .15	.15½ - .16
Boric, powder	lb.	.15½ - .16½	.17 - .18
Citric	lb.	.....	.46 - .48
Hydrochloric	100 lb.	1.60 - 1.70	1.75 - 2.00
Hydrofluoric, 52 per cent	lb.	.15 - .16	.16½ - .18
Lactic, 44 per cent tech	lb.	.10 - .11	.11½ - .12
Lactic, 22 per cent tech	lb.	.04½ - .05½	.06 - .07
Molybdic, C. P.	lb.	4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg.	lb.	.06½ - .07	.07½ - .07½
Nitric, 42 deg.	lb.	.07½ - .08	.08½ - .08½
Oxalic, crystals	lb.	.15 - .15½	.16 - .17
Phosphoric, Ortho, 50 per cent solution	lb.	.15 - .15½	.16 - .16½
Picric	lb.	.30 - .32	.35 - .40
Pyrogallic, resublimed	lb.	.....	2.30 - 2.40
Sulphuric, 60 deg., tank cars	ton	.....	.....
Sulphuric, 60 deg., drums	ton	.....	14.00 - 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 - 19.00	.....
Sulphuric, 66 deg., drums	ton	21.00 - 22.00	22.50 - 23.00
Sulphuric, 66 deg., carboys	ton	.....	.....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	23.00 - 24.00	.....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	25.00 - 26.00	26.50 - 27.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	32.00 - 35.00	40.00 - .....
Tannic, U. S. P.	lb.	.....	1.15 - 1.25
Tannic (tech.)	lb.	.45 - .47	.48 - .50
Tartaric, crystals	lb.	.....	.34 - .38
Tungstic, per lb. of WO	lb.	.....	1.00 - 1.20
Alcohol, Ethyl	gal.	.....	4.75 - 5.00
Alcohol, Methyl (see methanol)		.....	.....
Alcohol, denatured, 188 proof	gal.	.....	.44 - .50
Alcohol, denatured, 190 proof	gal.	.....	.51 - .54
Alum, ammonia lump	lb.	.04½ - .04½	.04½ - .05
Alum, potash lump	lb.	.05½ - .06	.06½ - .07
Alum, chrome lump	lb.	.13 - .13½	.14 - .14½
Aluminum sulphate, commercial	lb.	.02½ - .02½	.02½ - .03
Aluminum sulphate, iron free	lb.	.03 - .03½	.03½ - .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07 - .07½	.07½ - .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 - .32	.33 - .35
Ammonium carbonate, powder	lb.	.10 - .11	.11½ - .12
Ammonium chloride, granular (white salamoniac) (nominal)	lb.	.07½ - .08	.08½ - .08½
Ammonium chloride, granular (gray salammoniac)	lb.	.09 - .09½	.09½ - .10
Ammonium nitrate	lb.	.08 - .08½	.09 - .10
Ammonium sulphate	100 lb.	2.90 - 3.00	3.10 - 3.20
Amylacetate	gal.	.....	4.00 - 4.25
Amylacetate tech	gal.	.....	3.25 - 3.50
Arsenic oxide, (white arsenic) powdered	lb.	.09 - .09½	.10 - .10½
Arsenic, sulphide, powdered (red arsenic)	lb.	.14 - .14½	.15 - .15½
Barium chloride	ton	65.00 - 70.00	75.00 - 80.00
Barium dioxide (peroxide)	lb.	.18 - .19	.19½ - .22
Barium nitrate	lb.	.10 - .10½	.10½ - .11
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ - .05	.05½ - .06
Bleaching powder (see calc. hypochlorite)		.....	.....
Blue vitriol (see copper sulphate)		.....	.....
Borax (see sodium borate)		.....	.....
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.40 - .41	.42 - .45
Calcium acetate	100 lbs.	2.00 - 2.05	.....
Calcium carbide	lb.	.04 - .04½	.04½ - .05
Calcium chloride, fused, lump	ton	27.00 - 29.00	30.00 - 32.00
Calcium chloride, granulated	lb.	.01½ - .01½	.02 - .02½
Calcium hypochlorite (bleach'g powder)	lb.	.02½ - .02½	.03 - .03½
Calcium peroxide	lb.	.....	1.00 - 1.10
Calcium phosphate, monobasic	lb.	.....	.15 - .16
Camphor	lb.	.....	.75 - .77
Carbon bisulphide	lb.	.08 - .08½	.09 - .09½
Carbon tetrachloride, drums	lb.	.10 - .10½	.11 - .12
Carbonyl chloride (phosgene)	lb.	.....	.75 - 1.00
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.09 - .09½	.10 - .10½
Chloroform	lb.	.....	.38 - .40
Cobalt oxide	lb.	.....	3.00 - 3.10
Copperas (see iron sulphate)		.....	.....
Copper carbonate, green precipitate	lb.	.22 - .23	.24 - .25
Copper cyanide	lb.	.....	.50 - .60
Copper sulphate, crystals	lb.	.05½ - .05½	.06 - .06½
Cream of tartar (see potassium bitartrate)		.....	.....
Epsom salt (see magnesium sulphate)		.....	.....
Ethyl Acetate Com. 85%	gal.	.....	1.00 - 1.00
Ethyl Acetate pure (acetic ether 98% to 100%)		.....	.....
Formaldehyde, 40 per cent	lb.	.17½ - .17½	.17½ - .18
Fusel oil, ref.	gal.	.....	4.00 - 4.50
Fusel oil, crude	gal.	.....	2.50 - 2.75
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine, C. P. drums extra	lb.	.....	.19 - .20
Iodine, resublimed	lb.	.....	3.75 - 3.85
Iron oxide, red	lb.	.....	.10 - .20
Iron sulphate (copperas)	100 lb.	1.15 - 1.25	1.50 - 1.75
Lead acetate,	lb.	.....	.14½ - .16
Lead arsenate	lb.	.11 - .12	.12½ - .13
Lead nitrate	lb.	.....	.15 - .20
Litharge	lb.	.08½ - .09	.09½ - .10
Lithium carbonate	lb.	.....	1.25 - .....
Magnesium carbonate, technical	lb.	.10½ - .11	.11½ - .12
Magnesium sulphate, U. S. P.	100 lb.	2.25 - 2.75	.....
Magnesium sulphate, commercial	100 lb.	.....	1.70 - 2.00
Methanol, 95%	gal.	.....	1.02 - 1.05
Methanol, Colombian spirits	gal.	.....	1.25 - 1.30
Nickel salt, double	lb.	.....	.12 - .12½
Nickel salt, single	lb.	.....	.13 - .13½
Phosgene (see carbonyl chloride)		.....	.....
Phosphorus, red	lb.	.45 - .46	.47 - .50
Phosphorus, yellow	lb.	.....	.35 - .37
Potassium bichromate	lb.	.13 - .13½	.14 - .14½

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$ ... – $....	$0.30 –$0.35
Potassium bromide, granular	lb.	... –	.20 – .40
Potassium carbonate, U. S. P.	lb.	.35 – .40	.45 – .50
Potassium carbonate, crude	lb.	.08 – .08½	.09 – .10
Potassium chlorate, crystals	lb.	.08 – .10	.11 – .15
Potassium cyanide	lb.	... – ...	.45 – .50
Potassium hydroxide (caustic potash)	lb.	.10 – .11	.12 – .13
Potassium muriate	ton	60.00 – 70.00	... – ...
Potassium iodide	lb.	... – ...	2.75 – 3.00
Potassium nitrate	lb.	.09½ – .09¾	.10 – .12¼
Potassium permanganate	lb.	.45 – .46	.48 – .50
Potassium prussiate, red	lb.	.50 – .52	.53 – .55
Potassium prussiate, yellow	lb.	.28 – .29	.30 – .32
Potassium sulphate (powdered)	per unit	... – ...	... – 2.25
Rochelle salts (see sodium potassium tartrate)		... – ...	... – ...
Salammoniac (see ammonium chloride)		... – ...	... – ...
Salsoda (see sodium carbonate)		... – ...	... – ...
Salt cake	ton	... – ...	30.00 –33.00
Silver cyanide	oz.	... – ...	1.25 – ...
Silver nitrate	oz.	... – ...	.37½ – .38½
Soda ash, light	100 lb.	2.10 – 2.15	2.20 – 2.50
Soda ash, dense	100 lb.	2.20 – 2.30	2.40 – 2.60
Sodium acetate	lb.	.05½ – .05½	.06 – .06½
Sodium bicarbonate	100 lb.	2.60 – 2.75	3.00 – 3.25
Sodium bichromate	lb.	.08 – .08¼	.08½ – .08¾
Sodium bisulphate (nitre cake)	ton	7.00 – 7.50	8.00 –11.00
Sodium bisulphite powdered, U.S.P.	lb.	.05½ – .05¾	.06 – .06½
Sodium borate (borax)	lb.	.08¼ – .08½	.08½ – .09
Sodium carbonate (sal soda)	100 lb.	1.90 – 2.00	2.25 – 2.50
Sodium chlorate	lb.	.10 – .10½	.10½ – .11
Sodium cyanide, 96-98 per cent	lb.	.20 – .22	.23 – .30
Sodium fluoride	lb.	.13 – .13½	.14 – .14½
Sodium hydroxide (caustic soda)	100 lb.	3.60 – 3.70	3.80 – 4.00
Sodium hypo-sulphite	lb.	... – ...	.03½ – .04
Sodium nitrate	100 lb.	2.80 – ...	3.00 – ...
Sodium nitrite	lb.	.06 – .06¼	.06½ – .07
Sodium peroxide, powdered	lb.	.30 – .31	.32 – .34
Sodium phosphate, dibasic	lb.	.04½ – .04¾	.05 – .05½
Sodium potassium tartrate (Rochelle salts)	lb.	... – ...	.29 – .31
Sodium prussiate, yellow	lb.	.14 – .14½	.14½ – .14¾
Sodium silicate, solution (40 deg.)	lb.	1.25 – 1.35	1.40 – 1.50
Sodium silicate, solution (60 deg.)	lb.	.03 – .03½	.03½ – .03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.75 – 2.00	2.25 – 2.50
Sodium sulphide, crystal, 60-62 per cent (cone.)	lb.	.05 – .05½	.05½ – .06
Sodium sulphite, crystals	lb.	.04 – .04¼	.04½ – .05
Strontium nitrate, powdered	lb.	.16 – .16½	.16½ – .17
Sulphur chloride, red	lb.	.07 – .07½	.07½ – .08
Sulphur, crude	ton	16.00 –20.00	... – ...
Sulphur dioxide, liquid, cylinders	lb.	.08 – .08½	.08½ – .09
Sulphur (sublimed), flour	100 lb.	... – ...	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	... – ...	2.00 – 2.75
Tin bichloride, 50 per cent	lb.	.18 – .19	... – ...
Tin oxide	lb.	... – ...	.40 – .42
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran.	lb.	.11 – .11½	.11½ – .12
Zinc cyanide	lb.	.45 – .49	.50 – .60
Zinc dust	lb.	.12 – .13	.13½ – .14
Zinc oxide, XX	lb.	.09 – .09½	.09½ – .10
Zinc sulphate	lb.	.03½ – .03¾	.04 – .05

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.10 — $1.15
Alpha-naphthol, refined	lb.	1.45 — 1.50
Alpha-naphthylamine	lb.	.38 — .40
Aniline oil, drums extra	lb.	.22 — .26
Aniline salts	lb.	.28 — .32
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.00 — 1.50
Benzidine, base	lb.	.95 — 1.05
Benzidine sulphate	lb	.80 — .90
Benzoic acid, U.S.P.	lb.	.65 — .70
Benzoate of soda, U.S.P.	lb.	.65 — .70
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzyl chloride, 95-97%, refined	lb.	.30 — .35
Benzyl chloride, tech.	lb.	.25 — .30
Beta-naphthol benzoate	lb.	3.50 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech.	lb.	.34 — .40
Beta-naphthylamine, sublimed	lb.	2.25 — 2.40
Cresol, U. S. P., in drums (100 lb.)	lb.	.16 — .18
Ortho-cresol, in drums (100 lb.)	lb.	.23 — .25
Cresylic acid, 97–99%, straw color, in drums	gal.	.95 — 1.00
Cresylic acid, 95-97%, dark, in drums	gal.	.90 — .95
Cresylic acid, 50%, first quality, drums	gal.	.60 — .65
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	1.20 — 1.30
Dimethylaniline	lb.	.55 — .65
Dinitrobenzene	lb.	.30 — .32
Dinitroclorbenzene	lb.	.25 — .30
Dinitronaphthalene	lb.	.33 — .35
Dinitrophenol	lb.	.40 — .45
Dinitrotoluene	lb.	.27 — .30
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38 — .40
Diphenylamine	lb.	.60 — .70
H-acid	lb.	1.30 — 1.50
Meta-phenylenediamine	lb.	1.25 — 1.30
Monochlorbenzene	lb.	.14 — .16
Monoethylaniline	lb.	1.75 — 2.00
Naphthalene crushed, in bbls. (250 lb.)	lb.	.08 — .08½
Naphthalene, flake	lb.	.08½ — .08¾
Naphthalene, balls	lb.	.09¼ — .10
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.18 — .25
Ortho-amidophenol	lb.	3.20 — 3.75
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.75 — .80
Ortho-nitro-toluene	lb.	.20 — .24
Ortho-toluidine	lb.	.25 — .30
Para-amidophenol, base	lb.	1.90 — 2.00
Para-amidophenol, HCl	lb.	2.10 — 2.20
Para-dichlorbenzene	lb.	.15 — .20
Paranitroaniline	lb.	.90 — 1.05
Para-nitrotoluene	lb.	.90 — 1.05
Para-phenylenediamine	lb.	1.90 — 2.00
Para-toluidine	lb.	1.30 — 1.60
Phthalic anhydride	lb.	.55 — .60
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.12 — .14
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.85 — 2.00
Resorcinol, pure	lb.	2.30 — 2.50
Salicylic acid, tech., in bbls. (110 lb.)	lb.	.22 — .23
Salicylic acid, U. S. P.	lb.	.25 — .27
Salol	lb.	.85 — .95
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.28 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.16 — .18
Sulphanilic acid, crude	lb.	.30 — .35
Tolidine	lb.	1.35 — 1.45
Toluidine, mixed	lb.	.40 — .45
Toluene, in tank cars	gal.	.28 — .32
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.42 — .45
Xylene, pure, in tank cars	gal.	.45 — ...
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.24 — $0.26
Beeswax, refined, light	lb.	.27 — .28
Beeswax, white pure	lb.	.40 — .45
Carnauba, Flora	lb.	.68 — .70
Carnauba, No. 2, North Country	lb.	.30 — .32
Carnauba, No. 3, North Country	lb.	.18 — .19
Japan	lb.	.19¼ — .20
Montan, crude	lb.	.07 — .08
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04½ — .04¾
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.03 — .03¼
Paraffine waxes, refined, 118-120 m.p.	lb.	.04½ — .05
Paraffine waxes, refined, 125 m.p.	lb.	.05½ — ...
Paraffine waxes, refined, 128-130 m.p.	lb.	.06 — ...
Paraffine waxes, refined, 133-135 m.p.	lb.	.07½ — .07½
Paraffine waxes, refined, 135-137 m.p.	lb.	.08¼ — .09
Stearic acid, single pressed	lb.	.12 — ...
Stearic acid, double pressed	lb.	.12½ — ...
Stearic acid, triple pressed	lb.	.13½ — ...

Flotation Oils

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp.gr., 0.930-0.940	gal.	$1.70
Pine oil, pure, dest. dist.	gal.	1.60
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.	.48
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.	.36
Turpentine, crude, sp. gr., 0.900-0.970	gal.	1.20
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.	.37
Pinewood creosote, ref.	gal.	.55

Naval Stores

The following prices are f.o.b. New York for carload lots.

Rosin B-D, bbl.	280 lb.	$6.25	— ...
Rosin E-I	280 lb.	6.25	— ...
Rosin K-N	280 lb.	6.25	— ...
Rosin W. G.-W. W.	280 lb.	6.50	— ...
Wood rosin, bbl.	280 lb.	6.75	— ...
Spirits of turpentine	gal.	.61	— ...
Wood turpentine, steam dist.	gal.	.55	— ...
Wood turpentine, dest. dist.	gal.	.54	— ...
Pine tar pitch, bbl.	200 lb.	...	— 7.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	...	— 14.50
Retort tar, bbl.	500 lb.	15.00	— 14.75
Rosin oil, first run	gal.	.45	— ...
Rosin oil, second run	gal.	.48	— ...
Rosin oil, third run	gal.	.60	— ...

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.41
70-72 deg., steel bbls. (85 lb.)	gal.	.39
68-70 deg., steel bbls. (85 lb.)	gal.	.38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.30

Crude Rubber

Para—Upriver fine	lb.	$0.17	— $0.18
Upriver coarse	lb.	.13	— .14
Upriver caucho ball	lb.	.14	— .14¼
Plantation—First latex crepe	lb.	.19½	— ...
Ribbed smoked sheets	lb.	.17½	— ...
Brown crepe, thin, clean	lb.	.18	— ...
Amber crepe No. 1	lb.	.20	— ...

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.08½	— $0.09
Castor oil, AA, in bbls.	lb.	.10	— .10½
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.08	— .08½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.09½	— .10
Cocoanut oil, Cochin grade, in bbls.	lb.	.10	— .10½
Corn oil, crude, in bbls.	lb.	.08¼	— .08½
Cottonseed oil, crude (f. o. b. mill)	lb.	.04¼	— .05
Cottonseed oil, summer yellow	lb.	.07	— .
Cottonseed oil, winter yellow	lb.	.08	—
Linseed oil, raw, car lots (domestic)	gal.	.67	— .68
Linseed oil, raw, tank cars (domestic)	gal.	.60	— ...
Linseed oil, boiled, car lots (domestic)	gal.	.69	— .70

Olive oil, commercial	gal.	$2.20 —	$2.50
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.06½ —	.06¾
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.06 —	.06¼
Peanut oil, refined, in bbls	lb.	.11½ —	.12
Rapeseed oil, refined in bbls	gal.	1.05 —	1.10
Rapeseed oil, blown, in bbls	gal.	1.15 —	1.20
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.07½ —	.07½
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.04½ —	....
FISH			
Light pressed menhaden	gal.	$0.45 —	$0.47
Yellow bleached menhaden	gal.	.47 —	....
White bleached menhaden	gal.	.49 —	....
Blown menhaden	gal.	.84 —	....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00 —	26.00
Barytes, crude, 88% @ 94% ba., Kings Creek	net ton	10.00 —	17.00
Barytes, floated, f.o.b. St. Louis	net ton	26.50 —	28.00
Barytes, crude, first grade, Missouri	net ton	10.00 —	....
Blanc fixe, dry	lb.	.05 —	.05½
Blanc fixe, pulp	net ton	50.00 —	60.00
Casein	lb.	.14 —	.16
Chalk, domestic, extra light	lb.	.05 —	.05½
Chalk, domestic, light	lb.	.04½ —	.05
Chalk, domestic, heavy	lb.	.04 —	.05
Chalk, English, extra light	lb.	.05 —	.07
Chalk, English, light	lb.	.05 —	.06
Chalk, English, dense	lb.	.04½ —	.05
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	8.00 —	10.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	12.00 —	15.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	18.00 —	22.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	15.00 —	40.00
China clay (kaolin), imported, lump	net ton	23.00 —	25.00
China clay (kaolin), imported, powdered	net ton	30.00 —	35.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	gross ton	8.00 —	14.00
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00 —	30.00
Fullers earth, f.o.b. Mines	net ton	16.00 —	17.00
Fullers earth, granular, f.o.b. Fla	net ton	25.00 —	....
Fullers earth, powdered, f.o.b. Fla	net ton	18.00 —	....
Fullers earth, imported, powdered	net ton	35.00 —	40.00
Graphite, Ceylon lump, first quality	lb.	.08 —	.09
Graphite, Ceylon chip	lb.	.07 —	.08
Graphite, higher lubricating grades	lb.	.11 —	.40
Pumice stone, imported, lump	lb.	.04 —	.50
Pumice stone, domestic lump	lb.	.05 —	.05½
Pumice stone, ground	lb.	.06 —	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	.... —	10.00
Quartz (acid tower) 1¼@2 in., f.o.b. Baltimore	net ton	.... —	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	.... —	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	.65 —	....
Shellac, orange superfine	lb.	.70 —	....
Shellac, A. C. garnet	lb.	.57 —	....
Shellac, T. N.	lb.	.55 —	....
Soapstone	ton	12.00 —	15.00
Sodium chloride	long ton	14.00 —	15.00
Talc, paper-making grades, f.o.b. Vermont	ton	12.00 —	22.00
Talc, roofing grades, f.o.b. Vermont	ton	9.50 —	15.00
Talc, rubber grades, f.o.b. Vermont	ton	12.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	12.00 —	15.00
Talc, imported	ton	40.00 —	50.00
Talc, California talcum powder grade	ton	20.00 —	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	1,000	160
Chrome brick, f.o.b. Eastern shipping points	net ton	80–100
Chrome cement, 40–45% Cr_2O_3	net ton	45– 50
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	....– 55
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	55– 60
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	45– 50
Magnesite brick, 9-in. straight	net ton	100
Magnesite brick, 9-in. arches, wedges and keys	net ton	105
Magnesite brick, soaps and splits	net ton	120
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	65– 70
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	56– 61
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	50– 60

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochrome per lb. of Cr. contained, 6–8% carbon, carlots	lb.	.15 —	...
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.15 —	.16
Ferromanganese, 76-80% Mn, domestic	gross ton	90.00 —	95.00
Ferromanganese, 76-80% Mn, English	gross ton	90.00 —	95.00
Spiegeleisen, 18-22% Mn	gross ton	38.00 —	40.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.50
Ferrosilicon, 10-15%	gross ton	50.00 —	55.00
Ferrosilicon, 50%	gross ton	85.00 —	90.00
Ferrosilicon, 75%	gross ton	145.00 —	150.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.50 —	.55
Ferrouranium, 35-50% of U, per lb. of U content	lb.	7.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	5.00 —	6.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	gross ton	$10.00 —	$11.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.50 —	55
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	unit	50 —	55
Coke, foundry, f.o.b. ovens	net ton	5.50 —	6.50
Coke, furnace, f.o.b. ovens	net ton	4.50 —	5.00
Coke, petroleum, refinery, Atlantic seaboard	net ton	15.00 —	16.00
Fluorspar, lump, f.o.b. Hearhden, New Mexico	net ton	17.50 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	22.50 —	25.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	01½ —	01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	35 —	40
Manganese ore, chemical (MnO_2)	gross ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	55 —	60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	16 —	....
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	16½ —	....
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	12 —	.14
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.00 —	3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50 —	2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.50 —	....
Zircon, washed, iron free	lb.	.03 —	....

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	12.00@12.25
Aluminum, 98 to 99 per cent	28.3@28.5
Antimony, wholesale lots, Chinese and Japanese	5½@5¾
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, spot and bl eks	35
Monel metal, ingots	38
Monel metal, sheet bars	40
Tin, 5-ton lots	27.00
Lead, New York, spot	4.00
Lead, E. St. Louis, spot	3.95@4.00
Zinc, spot, New York	7.00
Zinc, spot, E. St. Louis	4.85

OTHER METALS

Silver (commercial)	oz.	$0.54¼
Cadmium	lb.	1.40
Bismuth (500 lb. lots)	lb.	1.50@1.65
Cobalt	lb.	4.50
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	70.00
Iridium	oz.	275.00@300.00
Palladium	oz.	65.00
Mercury	75 lb.	47.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.50
Copper bottoms	28.00
Copper rods	19.00@20.00
High brass wire and sheets	17.75
High brass rods	15.75
Low brass wire and sheets	20.75
Low brass rods	20.75
Brazed brass tubing	29.50
Brazed bronze tubing	34.75
Seamless copper tubing	22.50
Seamless high brass tubing	21.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York — Current	New York — One Year Ago	Cleveland	Chicago
Copper, heavy and crucible	10.00@10.25	18.50	10.00	10.50
Copper, heavy and wire	9.00@9.25	16.50	9.50	9.50
Copper, light and bottoms	7.50@8.00	14.50	9.00	8.50
Lead, heavy	3.00@3.50	7.25	4.00	4.00
Lead, tea	1.75@2.00	5.25	3.00	3.00
Brass, heavy	5.00@5.50	9.50	7.00	10.00
Brass, light	4.00@4.25	8.00	5.00	5.50
No. 1 yellow brass turnings	4.00@4.25	9.50	5.50	6.00
Zinc	2.50@3.50	5.00	3.00	3.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York — *Current	New York — One Month Ago	New York — One Year Ago	Cleveland — Current	Cleveland — One Year Ago	Chicago — Current	Chicago — One Year Ago
Structural shapes	$3.73	$3.80	$3.47	$3.58	$3.37	$3.58	$3.47
Soft steel bars	3.93	3.70	3.52	3.34	3.27	3.48	3.52
Soft steel bar shapes	3.93	3.70	3.52	3.48	3.27	3.48	3.52
Soft steel bands	4.33	4.65	4.22	6.25	....	....	....
Plates, ¼ to 1 in. thick	3.93	4.00	3.67	3.78	3.57	3.78	3.67

*Add 10c per 100 lb. for trucking to Jersey City and 15c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Arkansas

SAND SPRINGS—The Oklahoma Tanning & Mfg. Co., has acquired local property consisting of two factory buildings with adjoining site, and will remodel and equip the structures for a leather tannery. It is proposed to develop a total output of about 5,000 hides per day, with necessary plant extensions as required. Uley Holderman is president.

BATESVILLE—The White River Manganese Co., 567 Bway, Gary, Ind., will install considerable new machinery in connection with its development work on manganese properties at Batesville. Preliminary work has been commenced on a tract of over 100 acres, and it is proposed to establish a plant with daily output of about 50 tons. Washing and concentrating machinery will be purchased at an early date. William G. Rinehart is president and manager.

Florida

MIAMI, FLA.—The Moore Haven Sugar Corp., recently organized with a capital of $1,000,000, has taken over the plant and property of the Moore Haven Syrup Co., Moore Haven, Fla., consisting of a total of 8 mills on a tract of 450 acres of land. The plant will be remodeled to manufacture clarified raw sugar and byproducts, and new machinery will be installed for this purpose. It is proposed to develop the mills to a point of consumption of about 600 tons of sugar cane per day. The work, including machinery installation, is estimated to cost in excess of $500,000. E. C. George, Moore Haven, is president and general manager; John C. Grambling, Miami, is secretary and treasurer.

Indiana

KOKOMO—The Kokomo Steel & Wire Co., Citizens' Trust Bldg., has awarded a contract to the Indiana Bridge Co., Muncie, for the rebuilding of its steel works, recently destroyed by fire with loss estimated at about $300,000, including machinery.

ALEXANDRIA — The Lippincott Glass Co., Greenwood Bldg., Cincinnati, Ohio, manufacturer of chimneys, globes, etc., has commenced the construction of a large tenpot furnace at its plant at Alexandria. It is proposed to place the new furnace in operation at the earliest possible date.

Kentucky

LOUISVILLE — The Standard Sanitary Mfg. Co., Pittsburgh, Pa., manufacturer of sanitary earthenware products, is completing plans for the erection of a new unit at its Louisville works, to be 1 story, 75 x 200 ft., to be used for the manufacture of chinaware specialties, as handles, fittings, etc. It is proposed to have the pottery in operation at an early date.

Louisiana

ST. ROSE—The Petroleum Export & Import Corp., subsidiary of the Carson Oil Co., 29 South La Salle St., Chicago, Ill., is perfecting plans for the erection of a number of buildings on local site for a new oil refienery. The plant will cost about $500,000, with equipment. A battery of 20 storage tanks will be constructed, contract for which has been let to the William Graver Tank Corp., Chicago, Ill. A power plant, boiler house, pumping plant, machine shop and mechanical buildings will also be constructed. A factory for the manufacture of tin containers will be erected in conjunction with the works. Edward B. Carson is president of the parent company.

Maryland

BALTIMORE—The Prudential Oil Corp., Curtis Bay, is perfecting plans for the construction of its new local oil refinery, estimated to cost close to $1,000,000 with machinery. As preliminary to the work the company has filed plans for the construction of a series of steel oil tanks, with total capacity of about 275,000 bbl. The tankage system will cost about $75,000.

Massachusetts

HOLYOKE, MASS.—The Julid Paper Co. is reported to be planning for the rebuilding of the portion of its works destroyed by fire March 4, with loss estimated at $200,000.

NATICK—The Natick Tag & Label Co. has acquired the plant of the Natick Machine Co., Royal Arcanum Bldg., and will use the property in connection with its operations.

New Jersey

NEWARK—Keiner & Co., Inc., recently incorporated with a capital of $125,000, has acquired the plant of the Newark Paving Co., comprising a series of 1-story buildings on a tract bounded by Adams, Parkhurst and Harper Sts. and Ave. F, for the establishment of a new plant for the manufacture of tanning extracts. The property aggregates about 20,000 sq.ft., and about one-half of this space will be utilized at the present time. Equipment will be installed at an early date, including a leather finishing department. The lease covers a period of five years with option to purchase. The company is headed by Erich G. Keiner, Wilmington, Mass.; Irving Willner, 18 Waverly Ave., and Jacob Lubetin, 164 Market St., both of Newark.

GARWOOD—The American Amino Corp. is operating at its new plant at Matawan, N. J., and will produce a line of intermediates at this works. It will be operated in conjunction with the Garwood factory.

MAURER—The Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa., has filed plans for the erection of a new brick and steel building at its local asphalt works to cost about $101,000, to replace one of the sections of the plant recently destroyed by fire. Construction is under way on another large building at the refining plant to cost about $306,000; contract for this latter structure was let to the White Construction Co., 95 Madison Ave., New York.

New York

BROOKLYN—The Novocal Chemical Co., 2923 Atlantic Ave., is taking bids for extensions and improvements in its plant to cost about $35,000. The company has recently filed plans for extensions and betterments in another department of the works to cost $110,000. William C. Winter, 100 Van Sickler Ave., is architect.

BROOKLYN—The J. Lackner Co., 308 Seventh Ave., Long Island City, manufacturer of paper specialties, has filed plans for extensions and improvements in its plant to cost about $18,000.

TONAWANDA—The J. Spaulding & Sons Co., 484 Broome St., New York, manufacturer of fiber products, has preliminary plans under way for the erection of a new plant at Tonawanda, to consist of a series of 1-story buildings, with one 5-story structure. The factories will be 105 x 300 ft., 60 x 180 ft., and 50 x 200 ft. George F. Hardy, 309 Bway., New York, is engineer.

North Carolina

MORGANTOWN — The Burke Extract Co., manufacturer of tanning extracts, is planning for a number of extensions in its plant. It is proposed to install new machinery to increase the present output from 80 to 160 bbl. of tanning materials per day.

WAYNESVILLE—The Natural Abrasive Mining Co. of America, recently organized, has plans under way for the development of extensive properties in this section. The company has secured options on about 700 acres of land, containing mica, feldspar, abrasives and other minerals, and will conduct operations in these materials. A number of small plants in this district will be taken over and enlarged.

Pennsylvania

PITTSBURGH—The Standard Sanitary Mfg. Co., manufacturer of sanitary earthenware products, has filed plans for the erection of a new 2-story brick and steel addition on Ontario St. near Preble Ave., Northside, to cost about $50,000.

CURWENSVILLE—The Crescent Refractories Co., with local refactory manufacturing plant, has been merged with the George S. Good Fire Brick Co. and the Clearfield Clay Working Co., Clearfield, Pa., both manufacturers of similar products. The total output of the present plants will be about 275,000 refractory bricks and shapes per day.

GREENSBURG—The McKee Glass Co. has resumed production at its plant after a shutdown for about two months. It is proposed to increase production until normal is reached.

Texas

WACO—The Waco Producers' & Refining Co. has awarded a contract to R. E. Whitlock, Dallas, Tex., for the erection of a new refinery at South Bosque, near Waco, to cost about $75,000. It is planned to develop a daily output of about 300 bbl.

RANGER—T. S. Hudleston and associates have organized a new company to build a plant near Belton, Tex., for the manufacture of crockery and other pottery products. The company has acquired a site for the plant, as well as neighboring kaolin properties for raw material supply. The factory is estimated to cost about $200,000 with machinery.

MEXIA — The Mexia Refining Co. is planning for the construction of a new oil refinery with initial capacity of about 1,000 bbl. per day.

FREEPORT—The Freeport Sulphur Co. is planning for the construction of a new asphalt plant, to be operated in conjunction with its present local works.

HOUSTON—The Humble Oil & Refining Co. has arranged for note issue of $25,000,000, the proceeds to be used in part for proposed extensions, betterments, operations, etc. W. S. Farish is vice-president.

SAN ANTONIO—C. L. Witherspoon and associates are planning for the erection of a new oil refinery in the vicinity of Somerset, Tex., with daily output of about 1,000 bbl. A site has been selected.

Virginia

PEARISBURG—The Tazewell Brick Co. is planning for extensions and improvements in its plant at Tip Top, Va. The company was recently incorporated with a capital of $75,000. C. L. King is president.

STAUNTON—The Farmers' Marl Co., recently organized with a capital of $150,000, is planning for the development of extensive marl properties in this section. A plant will be established and equipped for a daily output of about 40 tons of material. The company holds leases to about 40 acres of land. C. J. Johne is president.

Washington

SPOKANE — The Washington Brick, Lime & Sewer Pipe Co. has acquired a tract of land on Monroe St., totaling about 65,000 sq.ft., as a site for the erection of a new brick plant. It is estimated to cost about $75,000. Construction will be inaugurated at an early date.

New Companies

THE INTERNATIONAL CHEMICAL CO., 13 West Saratoga St., Baltimore, Md., has been incorporated with a capital of $150,000 to manufacture chemical products. The incorporators are S. F. Acree, Wade A. Gardner and Carlyle Barton, Baltimore.

THE L. G. NESTER CO., Clayville, N. J., has been incorporated with a capital of $50,000 to manufacture surgical glassware specialties. The incorporators are Lyman G. Nester, William H. Hennis and A. C. Rosenberger, Clayville.

THE PHENIX MINERAL PRODUCTS CORP., New York, N. Y., has been incorporated with a capital of $100,000 to manufacture brick, ceramic tile and glassware products. The incorporators are J. and A. Levy, and H. M. Johnson, 26 Liberty St.

THE JOHN C. DOW LEATHER CO., Boston, Mass., has been incorporated with a capital of $50,000 to manufacture leather products. The incorporators are Charles W. Dow, Frederick S. Murphy and John C. Dow, 117 Eastern Ave., Lynn, Mass.

THE NORTH AMERICAN PETROLEUM CO., 2 West South Water St., Chicago, Ill., has been incorporated with a capital of $100,000 to manufacture oil products. The incorporators are Philip LaMantia, Joseph V. LaMantia and W. E. Gladstone.

THE ATLANTIC RUBBER ACE CO., New Brunswick, N. J., has been incorporated with a capital of $100,000 to manufacture rubber goods. The incorporators are Louis J., Edward L. and Conrad Sebott, 390 George St.

THE GARRETT PAPER CORP., Newton Square, Pa., has been incorporated with a capital of $30,000 to manufacture paper goods. C. E. Hand, Wyncote, Pa., is treasurer.

THE MARBO METAL PRODUCTS CORP., Calvert Bldg., Baltimore, Md., has been incorporated with a capital of 10,000 shares of stock without par value. The incorporators are Francis H. Stevenson, James A. Curtis and William H. Hill.

THE UNITED STATES PULP PRODUCTS CORP., Boston, Mass., has been incorporated under Delaware laws with a capital of $1,750,000 to manufacture pulp and paper products. The incorporators are Lindsey Hooper, Boston; Ernest L. Fox and L. G. Rowe, Newark, N. J.

E. BURNHAM, INC., 138 North State St., Chicago, Ill., has been incorporated with a capital of $250,000 to manufacture chemicals and byproducts. The incorporators are Gerald, M. and Edward Burnham.

THE BALDWIN PAPER MILLS, INC., New York, has been incorporated with a capital of $10,000 to manufacture paper goods. The incorporators are S. S. Himmel, H. Brownstein and H. E. Goldberg, 261 B'way.

THE EASTERN OIL & REFINING CO., Indianapolis, Ind., has been incorporated with a capital of $45,000 to manufacture refined oils. The incorporators are N. E. Carter, Daniel Hecker and B. H. Campbell, Indianapolis.

THE UNION CHEMICAL WORKS, 10 New York Ave., Union Hill, N. J., has filed notice of organization to manufacture chemicals and byproducts. The company is headed by Joseph B. Kreste.

THE BLANDFORD PAPER BOX CORP., Elmira, N. Y., has been incorporated with a capital of $100,000 to manufacture paper boxes and other containers. The incorporators are Herbert Blandford, Harold S. Mathews and Emil Jackson, Elmira.

THE OKLAMAR CO., 300 Continental Bldg., Baltimore, Md., has been incorporated with a capital of $100,000 to manufacture refined oils and kindred products. The incorporators are F. Craig Morton, Horace T. Smith and H. Webster Smith.

THE KENT AVENUE CHINA CO., Brooklyn, N. Y., has been incorporated with a capital of $100,000 to manufacture chinaware, pottery, etc. The incorporators are R. Deibel, J. H. Schwartz and M. Bergman, 1245 46th St.

F. PETER DEUGLER, INC., 190 North State St., Chicago, Ill., has been incorporated with a capital of $85,000 to manufacture chemicals and byproducts. The incorporators are J. C. Alten, C. C. Taylor and F. Peter Deugler.

THE CRYSTAL SHADE CO., Wheeling, W. Va., has been incorporated with a capital of $15,000 to manufacture porcelain goods. The incorporators are G. D. Foller, Harry E. Simpson and Frank McConnell, Wheeling.

THE PRUDENTIAL ALLOYS & CHEMICAL CO., 14 Lewis St., Newark, N. J., has filed notice of organization to manufacture chemicals and affiliated products. The company is headed by Herman Rubin, 56 Boyd St.

THE ROSE CLAY PRODUCTS CORP., Philadelphia, Pa., has been incorporated with a capital of $100,000 by Ernest R. and A. R. Rosse, Philadelphia; and Joseph R. Rosse, Essington, Pa.

THE VERIBEST CHEMICALS, INC., New York, N. Y., has been incorporated with a capital of $100,000 to manufacture chemicals and byproducts. The incorporators are S. Lyons, E. F. Rapp and B. M. Kaplan, 23 West 112th St.

THE NON-ALCOHOLIC PRODUCTS CO., 9 South 22d St., Irvington, Newark, N. J., has filed notice of organization to manufacture chemicals and affiliated products. William L. Zucker, 31 Ridgewood Ave., heads the company.

THE DI BELLA GLASS CO., Scott Depot, W. Va., has been incorporated with a capital of $10,000 to manufacture glassware. The incorporators are John Di Bella, T. Pine and E. A. Taylor, Scott Depot.

THE GAUER-LAWSON CO., 1202 Webster Ave., Chicago, Ill., has been incorporated with a capital of $5,000 to manufacture rubber goods. The incorporators are George A. Gauer, Frank B. Lawson and John F. Rau.

THE JOSEPH PETRY PRINTING INK CO., New York, has been incorporated with a capital of $25,000 to manufacture printing and marking inks. The incorporators are J. G. Snyder, A. W. Vanness and Joseph Petry, 261 West 27th St.

THE UNIVERSAL SPECIALTY CO., 975 West Side Ave., Jersey City, N. J., has filed notice of organization to manufacture chemical products. The company is headed by Gustav Levy.

THE UNITED STATES BOILER COMPOUND CO., 180 North Dearborn St., Chicago, Ill., has been incorporated with a capital of $10,000 to manufacture boiler compounds for water treatment. The incorporators are M. Black, M. and John L. Fox.

THE E. M. JAVITZ & SON CORP., New York, N. Y., has been incorporated with a capital of $10,000 to manufacture chemicals and affiliated products. The incorporators are J. Schanzenbach, A. and E. M. Javitz, 1 Hudson St.

THE PENN PAINT CO., Pittsburgh, Pa., has been incorporated with a capital of $25,000 to manufacture paint, oils, varnish, etc. C. D. Miller, 732 Whitney Ave., Wilkinsburg, Pa., is treasurer.

THE H. & J. BREWER CO., Springfield, Mass., has been incorporated with a capital of $96,800 to manufacture chemicals and affiliated products. The incorporators are Clinton E. Bell and G. E. Sheldon, Springfield, Mass.; and V. A. Converse, Longmeadow, Mass.

THE MCLEOD LEATHER & BELTING CO., Greensboro, N. C., has been incorporated with a capital of $200,000 to manufacture leather products. The incorporators are E. D. Broadhurst, Greensboro; W. T. McLeod and J. A. Schachner, both of Charlotte, N. C.

THE BISON PLATE & WINDOW GLASS CORP., Buffalo, N. Y., has been incorporated with a capital of $100,000 to manufacture glass products. The incorporators are G. F. Wallace, F. E. Trautman and E. J. Lienert, Buffalo.

THE CHIANAL CHEMICAL CO., 52 Hartford St., Newark, N. J., has filed notice of organization to manufacture special chemical products. The company is headed by John E. O'Sullivan.

THE OLYMPIC DISC RECORD CORP., 101 East Fayette St., Baltimore, Md., has been incorporated with a capital of $2,500,000 to manufacture composition products. The incorporators are D. L. Warner, Evan D. Llewellyn and Leslie E. Mihm.

THE AIMES MFG. CO., Jersey City, N. J. has been incorporated with a capital of $100,000 to manufacture chemicals, byproducts, drugs, etc. The incorporators are William D. P. Aimes and S. Walter Silverman, Philadelphia, Pa.; and Irving Solm, Bayonne, N. J.

Capital Increases, Etc.

THE GREAT EASTERN PAPER CO., INC., 377 Broadway, New York, N. Y., has filed notice of increase in capital from $30,000 to $100,000.

THE CELLULOID CO., 290 Ferry St., Newark, N. J., is arranging for an increase in capital from $6,000,000 to $10,098,000.

THE FRONTIER BRASS FOUNDRY, 818 Elmwood Ave., Niagara Falls, N. Y., has filed notice of change of name to the Frontier Bronze Corp.

THE VICTOR CHEMICAL WORKS, 343 South Dearborn St., Chicago, Ill., has filed notice of increase in capital from 55,000 shares to 100,000 shares of stock, no par value.

THE ATLANTIC PAINT CO., Charleston, S. C., has filed notice of increase in capital from $20,000 to $75,000.

THE REMINGTON PAPER & POWER CO., Watertown, N. Y., has filed notice of change of name to the Hanna Paper Corp., at the same time increasing its capital from $300,000 to $2,500,000 for expansion.

THE C. G. WINANS CO., 126 Frelinghuysen Ave., Newark, N. J., manufacturer of salt products, has filed notice of increase in capital from $80,000 to $160,000.

THE VULCANIZED RUBBER CO., 251 Fourth Ave., New York, N. Y., has filed notice of dissolution of its New York charter, to organize under Maine laws with a capital of $1,500,000.

THE E. J. KNAPP CANDLE & WAX CO., Free St., Syracuse, N. Y., has filed notice of increase in capital from $317,500 to $1,025,000.

THE INTERNATIONAL FOLDING PAPER BOX CO., 396 South Second St., Brooklyn, N. Y., has increased its capital from $50,000 to $250,000.

ELBERT & CO., 27 William St., New York, N. Y., manufacturer of oils, has increased its capital from $50,000 to $100,000.

Industrial Notes

CELLULOID ZAPON CO. announces the opening of a Philadelphia office at 520 Walnut St., in charge of B. O. Clausen.

MEIGS, BASSETT & SLAUGHTER, INC., consulting engineers, of Philadelphia, are making a survey of the Old Hickory plant near Nashville, Tenn., for the Nashville Industrial Corp.

ADAMSON MFG. CO., East Palestine, O., has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensors and a large line of arc-welded products adaptable to the chemical industry.

THE FANSTEEL PRODUCTS CO., INC., announces that since Jan. 27, 1921, the main office has been located at North Chicago, Ill.

THE JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J., has recently brought out a graphite evaporator plate which is recommended as a substitute for the ordinary laboratory sand bath.

EDW. R. LADEW CO., INC., of New York City, tanner and leather belt manufacturer, has closed its sales office at Charlotte, N. C., and transferred its Southern headquarters to 95 South Forsyth St., Atlanta, Ga. An ample stock of belting and leather specialties will be carried, with the usual facilities for special work and engineering service.

WESTERN FELT WORKS announces the completion and equipment of its new buildings at 4031 Ogden Ave., Chicago, Ill.

The metallic arsenic plant at the HOSKINS PROCESS DEVELOPMENT CO., Chicago, was partly destroyed by fire on Wednesday, Jan. 11. The property was covered by insurance and is being rebuilt.

CHAIN BELT CO., Milwaukee, Wis., announces that George J. Blanton, who for the past four years has been connected with the engineering sales department, has been made New York district manager. Before joining the company in 1917 Mr. Blanton was associated with the General Electric Co. for eight years, three years of which were spent in Schenectady, N. Y., and five in the Milwaukee office.

CONVEYORS CORP. OF AMERICA announces that E. D. Kellogg has recently been appointed New Jersey representative in the northern half of the state. His headquarters will be at the Eastern office, New York City. This company also announces that S. D. Inman has been placed in charge of the engineering and design of its American Trolley Carrier, monorail conveying equipment for handling coal, ashes, sand, gravel and like bulky materials from railway car to pile, bin or bunker. Announcement is also made that the Power Equipment Co., 131 State St., Boston, has been appointed as New England representative for the sale of its American Trolley Carrier, monorail equipment for handling coal, ashes, sand, gravel and other loose bulky materials. Colwell & McMullin, 79 Milk St., Boston, are the New England representatives for its American Steam Ash Conveyor.

C. H. WHEELER MFG. CO., Philadelphia, Pa., has opened a branch sales office in the Leader-News Bldg., Cleveland, O., with W. K. Eicher in charge.

HAZARD ADVERTISING CORP. announces its removal to more spacious offices at 7 East 42nd St., New York City, which was made necessary because of the steady increase in the volume of the company's business.

COLORADO FELDSPAR, FLINT & MICA CO., Denver, Col., is planning to establish a crushing and grinding mill at Golden, Col.

AMERICAN WRITING PAPER CO. announced a new scale of prices on Feb. 1. In the list price reductions up to 20 per cent are announced. The average figure, however, is about 15 per cent below January prices. The lines affected by the reduction include practically all papers made by the company except certain specialties.

N. B. PAYNE & CO., New York, dealers in electric cranes and hoists, have extended their lines of material handling machinery to include the portable conveyors of the A. C. Warner Co., Philadelphia; Chicago Automatic Coal Elevators and McKinney-Harrington Package Pilers and Car Loaders. Edmund Otto is now connected in this branch of their business.

THE QUIGLEY FURNACE SPECIALTIES CO., INC., announces that owing to the general development of its business, it has disposed of the metals department. The General Alloys Co., under the management of H. H. Harris, formerly in charge of the metals department, will continue with the sales of Q-alloys. The General Alloys Co. can be reached at either 122 South Michigan Ave., Chicago, Ill., or 26 Cortlandt St., New York City.

New Publications

BOOKS

THE CHEMISTS' YEAR BOOK, 1920. Edited by *F. W. Atack*, assisted by *L. Whinyates*. 5th ed., 1,136 pp. in two volumes. New York: Longmans, Green & Co., 1920. Price, $7 net.

Since 1915 these volumes have been issued annually in a form resembling the German Chemiker Kalendar. From year to year revisions have been made and new material has been added. In the present edition the 180-page section on "Physico-Chemical Constants" has been completely revised by Dr. G. Barr of the British National Physical Laboratory. As a reference book for general data and analytical methods it will be found convenient and comprehensive. Both editorial and mechanical make-up merit special commendation.

A DICTIONARY OF CHEMICAL TERMS. By *James F. Couch*, chemist, Bureau of Animal Industry, Department of Agriculture. Pp. 204. New York: D. Van Nostrand Co., 1920. Price, $2.50.

With the rapid growth and increasing specialization of chemistry new terms are often introduced in one branch of the science which are unfamiliar to workers in other fields. The chemist who tries to keep out of the rut by so planning his reading as to cover a broad field outside of his own specialty is often confronted with a new term or with a puzzling use of a common one. For the purpose of settling just such questions as those which have been suggested above Mr. Couch has unified the complex and scattered terminology of pure and applied chemistry, and presented the material in a form which lies somewhere between that of a standard English dictionary and that of an encyclopædia. Terms from related sciences which are likely to be met with are also defined, so that the book furnishes an excellent aid to study or reading any branch of chemistry or chemical engineering.

FROM NEWTON TO EINSTEIN. By *Benjamin Harrow, Ph.D.* Pp. 74. New York: D. Van Nostrand Co., 1920. Price, $1.

This little book presents in a very readable manner a summary of the changes which have taken place in our conception of the universe from Newton's time to the recent much-heralded verification of Einstein's theories. While entirely popular in style this book might serve as an introduction to a phase of physical chemistry, which is increasing in importance.

THE ENGINEERING INDEX, 1919. Pp. 528. New York: The American Society of Mechanical Engineers, 1920. Price, $4.

Covering as it does articles appearing in over 650 engineering and related publications this volume should be in the hands of all those who refer to the engineering literature. In securing the 12,000 items in this index the engineering staff reviewed approximately 1,100 periodicals, reports and other publications (in ten different languages) received regularly during the year by the Engineering Societies Library, New York.

CRAIN'S MARKET DATA BOOK AND DIRECTORY OF CLASS, TRADE AND TECHNICAL PUBLICATIONS. Chicago: G. D. Crain, Jr., 417 S. Dearborn St., 1921. Price, $5.

This book has been compiled primarily as a reference book for advertisers. The general field for advertising is divided into related groups or industries. For each of these a short summary is given, covering statistics as to size and importance, manufacturing operations involved (if an industry) and a review of materials and equipment required. This is followed by a list of publications serving this particular group, including circulation, type page, page rates and other matter of interest to advertisers. The industries treated include, among others: Brick and clay products; cement, lime, sand, gravel and other quarry products; chemical industries; gas; iron and steel, metal working; meat packing and byproducts; fertilizers; petroleum; paint and varnish; glass; paper; leather; sugar; rubber.

EXPORTER'S GAZETTEER OF FOREIGN MARKETS 1920-21. Compiled and edited by *Lloyd E. Morris*. Pp. 789, maps and tables. New York: American Exporter, 1920. Price, $10.

A vast quantity of up-to-date information on foreign markets has been gathered from scattered primary sources and arranged by countries under the main geographical divisions. For each country the book gives such data as: Area and population; commerce, statistics on industries and production; rivers, post offices, telegraphs, telephones and railroads; money, weights and measures; language; local advertising media; shipping routes; consular representatives, customs tariff and regulations; cable rate; mail time, and similar matters. Maps of the principal countries are included. Foreign currencies and measurements have been converted into American equivalents.

BIBLIOTHECA CHEMICO-MATHEMATICK: Catalogs of works in many tongues on exact and applied science, with a subject index compiled and annotated by H. Z. and H. C. S. These two volumes have 127 plates, which contain 247 portraits and facsimiles. Published by Henry Sotheran and Co., 140 Strand, W. C. 2, London, England. Price £3 3s.

HUMAN ENGINEERING, by Richard H. Mulliner, has just been issued. It is published by Mulliner Bros., 445 South Warren St., Syracuse, N. Y.

LABORATORY EXERCISES IN GENERAL CHEMISTRY, by William Martin Blanchard. Second edition. Published by D. Van Nostrand Co., N. Y. Price $1.25.

STANDARD TESTS FOR REAGENT CHEMICALS, by Benjamin L. Murray. Published by D. Van Nostrand Co., N. Y. Price $3.

PAMPHLETS

NEW BUREAU OF STANDARDS PUBLICATIONS: Circular 32, Standards for Gas Service; Circular 99, Carbonization of Lubricating Oils; Scientific Paper 399, Metallographic Etching Reagents: I—for Copper, by Henry S. Rawdon and Marjorie G. Lorentz; Scientific Paper 402, Use of Ammonium Persulphate for Revealing the Macrostructure of Iron and Steel, by Henry S. Rawdon; Scientific Paper 404, Magnetic Reluctivity Relationship as Related to Certain Structures of a Eutetoid-Carbon Steel, by C. Nusbaum, W. L. Cheney and H. Scott; Tech. Paper 173, Tests of Bond Resistance Between Concrete and Steel, by W. A. Slater, F. E. Richart and G. G. Scofield; Tech. Paper 178, Steel Rails From Sink-Head and Ordinary Rail Ingots, by George K. Burgess; Tech. Paper 179, Electric-Arc Welding of Steel: I—Properties of the Arc-Fused Metal, by Henry S. Rawdon, Edward C. Groesbeck and Louis Jordan; Tech. Paper 180, Causes and Prevention of the Formation of Non-condensible Gases in Ammonia Absorption Refrigeration Machines, by E. C. McKelvy and Aaron Isaacs.

NEW BUREAU OF MINES PUBLICATIONS: Petroleum Refineries in the United States, Tenth Annual Report of the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1920; Bull. 117, Structure in Paleozoic Bituminous Coals, by Reinhardt Thiessen; Bull. 189, Bibliography of Petroleum and Allied Substances in 1918, by E. H. Burroughs; Bull. 191, Quality of Gasoline Marketed in the United States, by H. H. Hills and E. W. Dean; Tech. Paper 251, Ventilation in Metal Mines, a Preliminary Report, by Daniel Harrington; Tech. Paper 255, Chlorination of Natural Gas, by C. W. Jones, V. C. Allison and M. H. Meighan; Tech. Paper 264, Storage Battery Locomotives, by L. C. Ilsley and H. B. Brunot; Tech. Paper 271, State Mining Laws on the Use of Electricity in and About Coal Mines, by L. C. Ilsley.

ANNUAL REPORT OF THE DIRECTOR OF BUREAU OF FOREIGN AND DOMESTIC COMMERCE to the Secretary of Commerce for the Fiscal Year Ended June 30, 1920.

NEW U. S. GEOLOGICAL SURVEY PUBLICATIONS: "World Atlas of Commercial Geology" Part I, Distribution of Mineral Production; I: 7, Secondary Metals in 1919, by J. P. Dunlop (Mineral Resources of the U. S., 1919, Part I), published Jan. 31. 1921; I: 8, Chromite in 1919, by J. S. Diller (Mineral Resources of the U. S., 1919, Part I), published Feb. 4, 1921; I: 28, Copper in 1918, by B. S. Butler (Mineral Resources of the U. S., 1918, Part I), published Sept. 28, 1920; I: 29, Lead in 1918, by C. E. Siebenthal (Mineral Resources of the U. S., 1918, Part I), published Jan. 6, 1921; II: 5, Sodium Compounds in 1919, by Roger C. Wells (Mineral Resources of the U. S., 1919, Part II), published Nov. 16, 1920; II: 6, Potash in 1919, by W. B. Hicks and M. R. Nourse (Mineral Resources of the U. S., 1919, Part II), published Dec. 8, 1920; II: 7, Strontium in 1919, by George W. Stose (Mineral Resources of the U. S., 1919, Part II), published Dec. 9, 1920; II: 8, Gypsum in 1919, by Ralph W. Stone (Mineral Resources of the U. S., 1919, Part II), published Dec. 28, 1920; II: 9, Mineral Waters in 1919, by Arthur J. Ellis (Mineral Resources of the U. S., 1919, Part II), published Jan. 21, 1921; II: 10, Sand and Gravel in 1919, by R. W. Stone (Mineral Resources of the United States, 1919, Part II), published Jan. 5, 1921; II: 12, Foreign Graphite in 1919, by Arthur H. Redfield (Mineral Resources of the U. S., 1919, Part II), published Feb. 5, 1921.

IMPERIAL MINERAL RESOURCES BUREAU has issued pamphlets on "Asbestos" and "Bismuth."

THE EXTRACTION OF POTASH FROM LOW-GRADE ALUNITE FROM MARYSVALE DISTRICT, UTAH, by Thomas Varley and W. Spencer Reid. Bull. 13 published by the Utah Engineering Station, Department of Metallurgical Research.

FOURTH ANNUAL REPORT of the United States Council of National Defense, for the fiscal year ended June 30, 1920.

DEPARTMENT OF LABOR AND INDUSTRY has issued a bulletin on "What Pennsylvania Is Doing for Safety and Safety Codes," by Dr. Clifford B. Connelley, and "Report of the Activities of the Industrial Board."

Coming Meetings and Events

AMERICAN CHEMICAL SOCIETY will hold its sixty-first meeting at Rochester, N. Y., April 26 to 29. Headquarters will be at the Hotel Rochester.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting at Atlantic City April 21 to 23 inclusive. Headquarters will be at the Hotel Chalfonte.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its spring meeting June 20 to 24 at Detroit. Industrial excursions will be made to Ann Arbor, Saginaw, Midland and Bay City.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its eighteenth annual meeting at the Hotel Ambassador, Atlantic City, June 9, 10 and 11.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN OIL CHEMISTS' SOCIETY (formerly the Society of Cotton Products Analysts) will hold its twelfth annual meeting in Chicago May 16 to 17.

AMERICAN PAPER & PULP ASSOCIATION will hold its annual meeting at the Waldorf-Astoria and Hotel Astor, New York City, April 11 to 15.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting at the Congress Hotel, Chicago, May 23 to 26.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its 1921 annual meeting in the New Monterey Hotel, Asbury Park, N. J., during the week of June 20.

CHAMBER OF COMMERCE OF THE UNITED STATES will hold its ninth annual meeting in Atlantic City April 27, 28 and 29.

HARVARD ALUMNI CHEMISTS' ASSOCIATION will meet Tuesday noon April 26 at Rochester, N. Y., for luncheon.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12, in the Eighth Coast Artillery Armory, New York City.

NATIONAL PETROLEUM CONGRESS will meet at the Hotel Baltimore, Kansas City, Mo., March 22 to 25.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

REFRACTORIES MANUFACTURING ASSOCIATION will hold a meeting at the Hotel Pennsylvania, New York City, March 17 to 19.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a meeting in Milwaukee April 27 to 29.

STAMFORD CHEMICAL SOCIETY, Stamford, Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.

TECHNICAL ASSOCIATION OF THE PULP & PAPER INDUSTRY will hold its annual meeting at the Waldorf-Astoria and Hotel Astor, N. Y., April 11 to 14.

The following chemical societies will meet at Rumford Hall, Chemists' Club, New York City, as follows: March 25, Society of Chemical Industry; April 22, Society of Chemical Industry, joint meeting with American Electrochemical Society, Société de Chimie Industrielle and American Chemical Society; May 6, American Chemical Society, Nichols Medal award; May 13, Société de Chimie Industrielle, joint meeting with American Chemical Society, Society of Chemical Industry and American Electrochemical Society; May 20, Society of Chemical Industry; June 10, American Chemical Society.